NATURE

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CONTENTS

	PAGE
Universities and Citizenship	929
Mathematical Biology. By Sir D'Arcy W. Thompson, C.B., F.R.S.	931
The International Congress of Zoology. By W. T. C.	932
Practical Genetics. By Prof. Eric Ashby	933
Bessel Functions. By A. C. A.	934
Aspects of High Polymeric Chemistry. By Prof. H. Mark	937
An African Survey	939
Czechoslovakia's Contributions to Science: A Survey and a Forecast. By Dr. Gerald Druce	942
Obituary Notices:	
Miss Clotilde von Wyss. By R. F. S.	944
Prof. Leonard S. Dudgeon, C.M.G., C.B.E. By R. T. H.	945
News and Views	946
Letters to the Editor:	
Distribution of the Bridled Form of the Common Guillemot (*Uria aalge*).—H. N. Southern	951
Tellurium Tetrafluoride.—G. A. R. Hartley, T. H. Henry and Prof. R. Whytlaw-Gray, O.B.E., F.R.S.	952
Fate of the Sulphate Radical in the Animal Body.—A. H. W. Aten, jun. and Prof. G. Hevesy	952
Distribution of Phosphorus in the Leg Bones of Chickens.—Dr. M. J. L. Dols, Prof. B. C. P. Jansen, Prof. G. J. Sizoo and G. J. van der Maas	953
Enzymic Deamination of Aspartic Acid.—Prof. Artturi I. Virtanen and Jorma Erkama	954
Oxygen Exchange during Esterification.—J. B. M. Herbert and I. Lauder	954
Crystal Analysis and Point Sets.—Dr. D. M. Wrinch	955
Ionization of Air in an Air-conditioned Building.—Dr. F. Běhounek and J. Kletschka	956
Velocity of Sound in Liquid Helium.—H. J. Groenewold	956
Vowel Vibrations and Vowel Production.—Sir Richard Paget, Bt.	957
Effect of Ultra-centrifuging the Oocytes of the Mouse.—Dr. R. A. R. Gresson	957
A Modified Phase Rule Equation.—George Novello Copley; Dr. S. T. Bowden	958
A New Decalcification Fluid.—R. A. C. Wilks	958
Binocular Illusion.—G. R. R. Bray	959
Research Items	960
The Present Position of Sociology	963
Agricultural Research in India	964
Radio Transmission and the Ionosphere	965
Acid and Basic Open-Hearth Steel-making Practice. By F. C. T.	966
Scientific and Industrial Research in Canada	966
Explorations of the Smithsonian Institution, 1937	967
Science News a Century Ago	968
Societies and Academies	968
Recent Scientific and Technical Books	Supp. v

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Universities and Citizenship

THE report of the 1938 congress of the National Union of Students, held at University College, Nottingham, which recently appeared under the title "The Challenge to the University" (London: National Union of Students), is a worthy successor to the admirable report on graduate employment issued last year. While disclaiming any attempt at an authoritative statement, it gives a stimulating picture of the way in which the problems of a university are being faced by the students themselves, and of the extent to which the suggestions and ideas of the report of the University Grants Committee have permeated the student body.

The report has indeed gained rather than lost in force through recent events, which have focused attention upon the importance of a definite national policy in regard to man-power and the most effective means of utilizing professional and technical workers in the national service in time of emergency. Every approach to the problem of national defence emphasizes the importance of leadership, whether we are considering the organization and utilization of national resources in a time of emergency, or the wider question of national reconstruction along lines which permit freedom for development and individual activity in time of peace, while providing the basis and framework of a defence policy adequate to meet the demands of any sudden emergency.

Leaving on one side some of the fundamental problems with which the issues of peace and war must always confront a university in its pursuit of learning and the disinterested search for truth, the problem of national defence poises problems of great magnitude to the university. Indeed, no plan or policy of national defence can be regarded as adequate which does not have regard to the position and contribution of the universities, while safeguarding their highest ideals and traditions. If a university is to participate actively in the task of national defence or preparation for defence, it cannot be on terms which violate its independence of thought or its loyalty to the aim of furthering human welfare and knowledge.

Two fundamental principles are urged in the report, namely, that the university should provide the means whereby its students can fit themselves adequately for an effective position in the vocational strata of society, and that it should assist its students to develop powers of thought and interest in the affairs and problems of the modern world, so that ultimately they may play a full and leading part in the life of the national and international community. These are indeed indispensable from the point of view of national efficiency.

The real problems arise, indeed, not from divergence of aim or principle, but from the question of methods. Methods which may best serve national efficiency from the point of view of national defence, at least on a short view, are not necessarily the best to safeguard the ideals or independence of the university or its teachers or students. One of the difficulties of the times is the necessity of confronting the totalitarian regimes, with their menace to independent and creative thought and man's richest spiritual heritage, with a discipline and organization no less resolute or capable of sacrifices because it safeguards the freedom of thought and love of justice which are the mainsprings of man's finest achievements. Upon the solution of this problem the future of mankind largely depends, and no policy for defence which ignores it can enlist the

enthusiasm and support which will safeguard and enrich the truths which democracy represents. The democracies have to meet the challenge by proving themselves able to add to their own noblest tradition and heritage.

This factor in itself should strengthen, for example, the appeal which appears even more clearly in the report in an address of Dr. F. Lincoln Ralphs for lecturers selected for the ability to inspire and expound rather than for their capacity for research. The consideration of man-power in relation to national defence throws into new relief the question of limiting the numbers of those who receive a university education, and the importance of ability being the sole criterion for entrance to a university. Again, the point of view of national defence strengthens the case so ably argued in the report for greater attention to the physical well-being of students and attempts to raise their general standard of physique, whether by measures designed to prevent illness or under-nourishment, the extension of medical examination, further provision for the treatment of illness, whether by the extension of health insurance or in other ways, or by increased provision for physical training and exercise.

It can scarcely be denied that in many of these respects the democracies have lagged behind the totalitarian States, and if the necessity for an effective policy for national defence stimulates action to improve the situation, while still safeguarding the independence and integrity of the universities, the recent crisis may not have been without its gains. Even from the point of view of national defence, the broadening of university training is desirable to stimulate the growth of the virile citizenship upon which the continuance of democracy depends. Any measure which checks excessive specialization, encourages a knowledge of public affairs, the ability to think clearly and critically not merely in abstract fields but also in regard to the complex affairs of human society, and the power of disinterested thought, in itself is a step to the provision of the wise and intelligent leadership needed.

The report provides welcome evidence that the responsibilities of citizenship are recognized by a growing section of students themselves no less than of the university authorities, and the consensus of opinion revealed encourages the hope that, in Great Britain at least, the demands of a defence policy upon the universities will be met without encroaching on their inherent freedom of thought, investigation or teaching. It should not be forgotten, however, that many of the measures outlined in the report for improving the present position turn essentially on finance. Increase in staff, extension of maintenance grants, provision of new buildings, libraries, etc., may all be required, and the report stresses the need for an increase in the Treasury grants to the universities.

Under the present conditions, it is unlikely that such an increase can be looked for, except as part of a comprehensive and long-range view of the national resources such as is involved in the formulation of a definite policy of national defence covering the resources of man-power no less than of material resources, and in which the contribution and place of the universities are fully considered. Any such review can scarcely fail to lead to increased provision for the care of student health and for physical training and other means designed to assist the student to take a fuller part not only in the communal life of the university itself, but also in that of the community at large.

If, however, the bearing of such aspects of student life on national service is more obvious, the more fundamental contribution of the university should not be overlooked. It is only as a democracy can provide the leadership which is not content merely to rest in the past, but can make positive contributions to the solution of the problems of to-day, bringing to bear upon them constructive and creative minds, which in courage, resourcefulness and self-discipline are at least the equal of any to be found in the totalitarian regimes, that it can hope to survive. In the long run, it is on the universities, which safeguard freedom of thought and investigation, of learning and impartial criticism, that democracy must rely, both for the supply of leaders and for the vision and inspiration which will enable it to meet the greater demands of the present day.

The significance of this contribution has been emphasized by the recent unhappy events in Germany. The horror and revulsion with which the world regards the further persecution and suffering inflicted upon those of Jewish origin have brought also the realization how fragile are the barriers between us and relapse into barbarism. Only wise and independent leadership alive to human values and capable of impartial and constructive criticism can save a nation, be it under totalitarian or democratic government, from the many dangers which attend mass hysteria and propaganda.

Mathematical Biology

Mathematical Biophysics:
Physicomathematical Foundations of Biology. By Nicolas Rashevsky. Pp. xviii + 340. (Chicago: University of Chicago Press; London: Cambridge University Press, 1938.) 18s. net.

SOME ten years ago, Dr. Nicolas Rashevsky, then a young mathematical physicist, turned his mind to biological problems; and ever since he has been writing papers on the borderland between physics and biology, too hard and too speculative for some, but which others have read with great interest and attention.

Dr. Rashevsky has a way of his own. He is neither observer nor experimenter. His business is to reflect on what other men have seen or discovered, to interpret it anew, and to use the help which mathematical methods give to guide his thoughts and help his reasoning. The physicist deals with atoms of extreme complexity, but only yesterday thermodynamics were well and truly laid on molecules as simple as billiard-balls. The histologist keeps adding to our knowledge of the complex structure of the cell, but Dr. Rashevsky would have us meditate over an imaginary cell, simplified almost out of all knowledge. A first approximation based on so simplified or idealized a cell must be far from the whole truth; but it may be a first step on the way to comprehension.

We may simplify our cell as we like, even reduce it to a little structureless sphere, but it must still be a seat of chemical activity and change. What leads to cell-division in such a cell is the first question Dr. Rashevsky asks. The ratio of volume to surface increases as the cell grows, and the due balance between them is lost thereby; this is true and obviously true, but what does it mean? In its constant metabolism things enter the cell, suffer change within it and pass out again; diffusion goes on both without and within; diffusion currents are set up, diffusion gradients are established, and forces act proportionally to the gradients of osmotic pressure. The cell is a seat of energy and a 'centre of force'; for the old phrase which Goodsir used nearly a hundred years ago turns up again, with its meaning a little altered and better defined.

In the simple, homogeneous spherical cell the resultant forces will be nil. In a slightly deformed sphere absorption or diffusion inwards will tend to set it right; but the diffusion outwards of substances formed within will tend to distort it the more, and in certain circumstances these latter forces actually tend to split the cell. They have against them the force of surface tension, a powerful opponent so long as the cell is small; there must be some critical size where the forces leading to deformation get the upper hand and diaruption or cell-division ensues. On such lines as these, but with the argument illustrated mathematically, in ways that are always lengthy and often hard, Dr. Rashevsky discusses cell-division, and arrives at certain tentative quantitative solutions, which turn out to be of the order of magnitude of ordinary cells. He goes on to discuss some of the many cells which, like a red blood corpuscle, a *Euglena* or a *Paramecium*, are very far from spherical, but are yet able to maintain themselves in quasi-equilibrium or a steady state, so long as their metabolism continues and a given distribution of forces is maintained. But we must not suppose, nor does Dr. Rashevsky attempt to persuade us, that the road is easy or our course assured. It is a difficult business all along; and in an interesting appendix (to which Dr. Gale Young's work contributes) the main discussion is somewhat simplified and is certainly improved. Formidable difficulties remain. The case of the slightly deformed cell is not difficult to understand, but the successive stages culminating in division are hard to follow. Then comes the further difficulty that no two cells are quite alike; they have their little differences in outward form and greater differences in internal content, and these differences would greatly affect our calculations if we did not neglect them one and all. Yet life goes on just the same in all of them, and the mode and rate of cell-division seem insignificantly changed.

Beginning with the dividing cell, the first half of the book keeps in view, as a far-off aim, nothing short of a physico-mathematical theory of organic form; the latter half passes on to physiological questions, concerning nervous irritability, excitation, inhibition, conduction and reflex action. An interesting chapter (xvii) reprints a five-year-old paper of the author's*, in which he explained nervous excitability on lines analogous to A. V. Hill's well-known two-factor theory, but somewhat vaguely based on Jacques Loeb's work on the effect of relative concentrations of antagonistic ions. He looks on the nerve as likewise containing two antagonistic substances the relative concentration of which leads at a certain point to excitation. When a current passes along the axon, ionized

* Outline of a Physico-Mathematical Theory of Excitation and Inhibition, *Protoplasma*, **20**, 42–56 (1933).

substances flow one way or other; and according as the inhibiting and exciting substances go to or fro, and go the same or opposite ways, various significant possibilities occur, some of them such as have received experimental confirmation at A. V. Hill's hands.

Dr. Rashevsky starts afresh with the volley of impulses which Adrian finds set up in a nerve-fibre, with a vibrational frequency varying as the intensity of the stimulus. When correlated with the same two factors in a diagrammatic system of neurones and synapses, with a finite velocity in the one and a finite delay in the other, many curious possibilities emerge. A continual stimulus may lead to brief inhibition and lasting excitation, or to just the converse; a sudden stoppage of the inhibitory stimulus must, in other circumstances, lead to Sherrington's 'rebound' phenomenon, or something very like it; and a certain particular distribution, or pattern, of peripheral stimuli will lead to a maximum or optimum stimulation at the centre. But here, and in all his other physiological chapters, the weakness of the author's speculative method is more apparent than in his theories of the division of the cell. For a certain amount of pure speculation comes in handy, and is even welcome, in a case all but beyond the reach of experiment; but nerve-physiology is another story. Sometimes the mere throwing of a phenomenon into mathematical form opens our eyes to something new, as when Lotka and Volterra gave mathematical precision to vague instances of the struggle for existence. But it oftener happens that mathematical symbolism leaves us just where we were before, and merely expresses perfectly general relations, where we had looked for something which should apply to and elucidate a specific case. What Michel Petrovich called the "Mécanismes communs aux phénomènes disparates" illustrate over and over again the unimportance of mathematical analogy, and the need for something more than mathematical symbolism.

We may admire Dr. Rashevsky's learning and borrow ideas from his ingenuity, but the physiologists will go on experimenting in their own old way. Sir Charles Lyell said to the geologists, "Travel, travel, travel!"; and the physiologists say to one another, "Experiment, experiment, experiment!".

D'Arcy W. Thompson.

The International Congress of Zoology

12e Congrès international de Zoologie tenu à Lisbonne du 15 au 21 Septembre 1935
Comptes Rendus. Vol. 1. Pp. xix + 228 + 644 + 30 plates. Vol. 2. Pp. 645–1514 + 41 plates. Vol. 3. Pp. 1515–2424 + 28 plates. (Lisboa: Casa Portuguese, 1936–1937.) n.p.

THE proceedings of the twelfth International Congress of Zoology which met at Lisbon in September 1935 have now been published in three handsome volumes, which form part of the series "Arquivos do Museu Bocage" issued by the Zoological and Anthropological Section of the National Museum at Lisbon. About two hundred papers communicated to the Congress are printed in full in the three volumes (each of nearly nine hundred pages) and they are illustrated by a hundred plates, some of which are in colour, in addition to many text-figures. The preparation and editing of this vast amount of material (in five languages) must have imposed a heavy burden on Prof. A. R. Jorge, the president, and Prof. F. Frade, the general secretary of the Congress, and they are to be unreservedly congratulated on the result. The printing and illustrations reach a very high standard, and it is evident that neither trouble nor expense has been spared. Those who had the good fortune to experience the lavish hospitality with which the Congress was entertained at Lisbon will be grateful to their Portuguese hosts for having provided such a worthy record of a memorable occasion.

It is assuredly not to be laid to their charge if the general scientific interest of these volumes does not, on the whole, rise much above what one is accustomed to expect in the reports of international congresses. There are some addresses, especially among those delivered at the plenary sessions of the Congress, handling major questions of biology, which every zoologist will be glad to have upon his shelves. Similarly, in the more specialized proceedings of the various sections, there are many papers which will appeal to a much wider audience than was able to hear them delivered at Lisbon. Nevertheless, it is evident that there are many who see in the proceedings of an international congress merely another vehicle for the publication of papers dealing with matters of detail and often of the most limited interest even to specialists. One would have thought it self-evident that descriptions of new species were entirely out of place in such a publication; but there are several papers in these volumes that consist of little else. Very little general discussion took place on the papers read, and still less is here recorded in print.

In the present state of world affairs, any measures that facilitate intercourse and co-operation between scientific men in different countries are deserving of the fullest support. Among such measures the holding of periodical congresses is one of the most important and valuable, and those who undertake the heavy tasks of organizing and preparing for them deserve the gratitude of their colleagues. It may seem ungracious to suggest adding to these tasks, but there are certain reforms which, if they could be carried out, would add greatly to the interest and effectiveness of the meetings. A group of the British delegates to Lisbon has already suggested to the permanent committee that future congresses might be made more profitable to those taking part if discussions could be arranged, based upon papers which, instead of being read at the meeting, were printed and circulated to the members in advance. This method has been adopted with success at certain international congresses of more limited scope, and while there would be obvious difficulties in the case of so vast and diversified a field as that covered by zoology, it would be well worth while to try the experiment on a future occasion.

One of the most successful attempts at international co-operation organized by previous meetings of the Congress of Zoology has been the International Commission on Zoological Nomenclature. If its decisions have not always received the unanimous assent of zoologists, it has rendered an immense service by providing the only code of zoological rules that has any claim to international authority. At Lisbon, it was able to present a report recording considerable further advances towards a stable system of nomenclature. One particularly hopeful step was the adoption of a long list of *nomina conservanda*, in which changes that would have led to serious confusion are avoided by suspension of the rules in the individual cases. Most unfortunately, owing to causes that could not have been foreseen, the Commission has been in a state of suspended animation since the Lisbon meeting. It is to be hoped that it will be able to resume its beneficent labours before long. W. T. C.

Practical Genetics

(1) Handbuch der biologischen Arbeitsmethoden Herausgegeben von Prof. Dr. Emil Aberhalden. Lief. 466. Abt. 9; Methoden zur Erforschung der Leistungen des tierischen Organismus, Teil 3, Heft 7 (Schluss). Methoden der Vererbungsforschung. Methoden zur Zuchtung von Drosophila von G. A. Lebedeff; Methoden der Erforschung der Vererbungsvorgänge bei Pflanzen, von F. G. Brieger; Methoden und Ergebnisse bei der Zuchtung von Tetriginæ, von Robert K. Nabours. Pp. 115–1402 + xiii. (Berlin und Wien: Urban und Schwarzenberg, 1937.) 17 gold marks.

(2) Practical Plant Breeding
By W. J. C. Lawrence. Pp. 155. (London: George Allen and Unwin, Ltd., 1937.) 5*s*. 6*d*. net.

IN a recent issue of NATURE (138, 972; 1936) there appeared a letter directing attention to the neglect of genetics by British universities. The letter was received with the apathy characteristic of British biology where genetics is concerned. No one denied the need for genetics in universities, but only one correspondent supported it. Meanwhile we have come to rely on the U.S.S.R. and the United States to lead the world in genetical research. Although plant breeding has now become one of the foremost activities in the agriculture of the British Empire, and despite the stimulus provided by such institutions as those at Edinburgh and at Merton, many universities offer no more than half a dozen lectures on primitive Mendelism under the title "Evolution and Heredity", and practical teaching in genetics is confined to three or four departments. The four works which come under review in this notice should remove one of the last excuses for shirking practical classes in genetics.

(1) Dr. Lebedeff, in the compass of 67 pages, sets out clearly all the information one is likely to need for culture work with *Drosophila*: rates of development at different temperatures, data on fertility, technique for dealing with stock, preparation of media and construction of thermostats, methods of counting eye facets, cytological technique (contributed by Dr. Stern), and X-ray analyses.

Dr. Brieger's contribution on methods in plant genetics covers a wide field. He presents data on the size of populations required for estimating segregation with precision, and on the technique of hybridization, and there follows a synopsis of statistical methods. The synopsis contains a number of useful tables, but does not provide either theoretical treatment of the formulæ or practical examples on applications of genetics. There is a section on the various kinds of Mendelian segregation and upon methods of calculating linkage; and three pages on useful methods for making cytological preparations.

Dr. Nabours' contribution on the grouse-locust contains more results than methods. It is a useful

summary of the work on the genetics and cytology of Tetriginæ (Orthoptera), and includes details of X-ray work on *Apotettix*, on parthenogenesis and the inheritance of colour-patterns.

(2) Mr. Lawrence modestly describes "Practical Plant Breeding" as a guide-book for the enterprising gardener. This function it will most certainly perform, but it can be recommended to a wider public. Chapters iv and v contain within fifty pages an account of Mendelism and the cytological basis of inheritance excellently suited for elementary students. The chapters on the technique of hybridization and on methods of plant improvement are as appropriate for the enterprising university teacher as for the enterprising gardener. Mr. Lawrence's style is easy and clear. The book, and the technique it describes, should be introduced into the botany departments of all universities still at the 'six-lectures-on-evolution-and-heredity' stage.

ERIC ASHBY.

Bessel Functions

Bessel Functions
Part 1: Functions of Orders Zero and Unity. (British Association for the Advancement of Science. Mathematical Tables, Vol. 6.) Prepared by the Committee for the Calculation of Mathematical Tables. Pp. xx+288. (Cambridge: At the University Press, 1937.) 40*s*. net.

THE worthy completion of a long and arduous task will always draw from the beholder the tribute of an almost personal gratification. Our sympathy and interest are at once enlisted by the opening sentences of Prof. E. H. Neville's preface to the latest volume of the British Association mathematical tables, Volume 6, a table of Bessel functions of orders zero and unity: "It is with the satisfaction of keeping a long-anticipated engagement that a Committee of the British Association issues its first volume of tables of Bessel functions. Half a century ago, the Committee decided that the tabulation of Bessel functions was the most useful undertaking that it could promote". Our sympathy is deepened when we read that Prof. Alfred Lodge, who had been one of the original Committee of 1889 and to whom this handsome volume is dedicated in terms of grateful affection, died on the very eve of its publication.

The tables appear to the reviewer to be as much above praise as they are beyond criticism. In the course of a most valuable and interesting account of the constructing and multiple checking of the tables (an account which includes a list of errors discovered in pre-existing tables of Bessel functions) Dr. L. J. Comrie, a member of the Committee, states that in the reading of proofs not a single compositor's error was found in some 280 pages containing just under a million figures. He expresses the belief that the tables are completely free from error; and no one has a better right to be believed in such a matter.

The tables are principally of the functions (to use the most accepted notation) $J_0(x)$, $J_1(x)$, $Y_0(x)$, $Y_1(x)$, $I_0(x)$, $I_1(x)$, $K_0(x)$, $K_1(x)$, of the last two multiplied by e^x and e^{-x} respectively, and short tables of e^x and e^{-x} themselves. In addition there are tables of the first 150 zeros of $J_0(x)$ and $J_1(x)$, with the value of the other of the two functions for each zero; and a similar table of the first 50 zeros of $Y_0(x)$ and $Y_1(x)$. The most extensive tables, occupying some 170 pages, are those of $J_0(x)$ and $J_1(x)$ to ten decimal places, from $x = 0$ by steps of 0·001 to $x = 16$, then by steps of 0·01 to $x = 25$. Those for $Y_0(x)$ and $Y_1(x)$ are from $x = 0$ by steps of 0·01 to $x = 25$; those for $I_0(x)$ and $I_1(x)$ are to eight decimal places, from $x = 0$ by steps of 0·001 to $x = 5$; those of $K_0(x)$ and $K_1(x)$ are to ten places, from $x = 0$ by steps of 0·01 to $x = 5$; the products of these by exponential functions carry the range to $x = 10$, then by steps of 0·1 to $x = 20$. Interspersed are pages of formulæ and recurrence relations, asymptotic series and tables of auxiliary functions. All tables are supplied with second central differences; and the last four pages provide Everett and Bessel interpolation coefficients, with a short description of how to use them.

It is pleasant to read of the generous co-operation of Prof. K. Hayashi, who allowed the Committee to use his own published tables, and of Prof. H. T. Davis, who provided the Committee with a 15-decimal manuscript table of his own, and renounced publication of this in favour of the Committee.

Nothing remains but to congratulate the Committee. Table-making is an art in which beauty and utility are interfused and indivisible. This book more than maintains the high standard set by its predecessors in the series. It is gratifying to learn that a second volume of Bessel functions, of other integral orders, is "in an advanced state of preparation".

A. C. A.

Statistical Year-Book of the World Power Conference No. 2: Data on Resources and Annual Statistics for 1934 and 1935. Edited, with an Introduction and Explanatory Text, by Frederick Brown. Pp. 132. (London: World Power Conference, 1937.) 20*s*. net.

THIS Year-Book represents a further stage in the attempt of the World Power Conference to compile international statistics of power resources, development and utilization upon a comprehensive and comparable basis. As in the first publication (1936), definitions of each power-type, together with uniform tables, were supplied to national committees and other organizations for their returns. Ambiguities and minor defects discovered in these definitions during preparation of the first Year-Book were rectified before circulation, and a corresponding improvement is reflected in this second volume.

Admittedly a certain amount of additional data extracted from published sources could have been added, had they been expressed in similar units to those adopted by the World Power Conference, to make the work even more complete; but throughout the volume the editor has followed a policy of including only those data which conform closely to the definitions adopted as standard for this work. The statistics presented, therefore, may be regarded as accurate from the point of view of comparison with each other, though they are in no sense claimed to be comparable with other published statistics.

Statistics relating to production and distribution of manufactured gas and to production, stocks, imports, exports and consumption of coke, are included in this volume for the first time. Indeed, with the exception of wind and sun power, which the compilers state are the principal omissions, practically every type of solid, liquid and gaseous fuel, together with water-power and electricity, has been dealt with.

Animal Life in Fresh Water:
a Guide to British Fresh-water Invertebrates. By Dr. Helen Mellanby. Pp. viii+296. (London: Methuen and Co., Ltd., 1938.) 8*s*. 6*d*. net.

IN recent years, partly as a result of the establishment of the Freshwater Biological Association's station on Lake Windermere, there has been in Great Britain a welcome revival of interest in the fresh-water fauna and flora. The ease with which many types can be obtained almost everywhere and kept alive in small aquaria makes them very suitable material for the school teaching of biology, and Mrs. Mellanby's book has been planned to provide a guide for school teachers and pupils. For this purpose it is in many ways well adapted.

A large number of common invertebrate types are described and figured in sufficient detail to enable the elementary student to identify his captures approximately, and some account is given of the more important features of their habits and life-histories. It is much to be regretted, however, that a little more care has not been taken with its compilation. Misspellings such as "ciliæ", "flagellæ", "lacustræ", "*Chironomous*", "*Notamma*" (for *Notommata*) "*Chælonotus*" (for *Chætonotus*) and the like occur on almost every page and will cause needless trouble to the student. The style is sometimes slipshod, as, for example, where it is said that the Spongilla fly (*Sisyra*) "is not very common, but this may be due to its being small and inconspicuous". A sedentary animal attached to the body of another animal is by no means an "epiphyte", and the colour of grey or brown specimens of *Hydra* is not due to "zoochlorellæ". W. T. C.

Modern Physics:
a Second Course in College Physics. By Prof. G. E. M. Jauncey. Second Edition. Pp. xviii+602. (London: Chapman and Hall Ltd., 1937.) 22*s*. net.

THAT Prof. Jauncey's book, now appearing in a second edition, has been reprinted three times since its first publication in 1932 is sufficient testimony to its usefulness. The date of the first edition gives a hint of the principal additions to be expected, and to be found, in this new edition. Besides these additions, which have involved much re-arrangement and re-writing, chapters on wave motion, the new quantum theory and physics of high pressure have been added.

For the information of new readers, it should be stated that Prof. Jauncey's book contains a fair measure of classical and introductory work, including chapters on alternating currents, the electromagnetic theory of radiation, gas-kinetic theory, geophysics, and astrophysics, to mention five out of the twenty-six chapters which go to make up the book. One chapter deals with "Some Useful Mathematics", and this chapter, in view of the demands on the space allotted to the volume, could be curtailed with advantage; the quite elementary calculus considerations are surely unnecessary to the type of student likely to benefit by the study of the book which, considered as a whole, is an admirable elementary introduction to the study of the problems of modern physics. But Prof. Jauncey should not describe Maxwell, who was a distinguished exponent of the art of writing light verse, as "given to writing verses of the jingle type". A. F.

A Text-Book of Physics
By Dr. D. B. Deodhar. Pp. vi+672. (Allahabad: The Indian Press, Ltd., 1937.) 6 rupees.

DR. DEODHAR has produced a useful text-book of physics for students of intermediate grade. The book covers rather more than the usual ground; the topics are discussed clearly and, in some instances, a little more fully than is commonly the case. There is a good selection of examples, and a welcome feature of the book is the number of succinct descriptions of applications of physical principles to technical instruments.

The book bears signs of hurried writing—Foucault appears consistently as Focault, and there is a remarkable diagram showing the ascent of mercury in an open tube. Mass is quantity of matter, Newton's law of cooling is treated as an approximation valid

only for small temperature-excesses, and the effect of temperature on the velocity of sound is given in the form $v = v_0 (1 + \frac{1}{2}\alpha t)$. It is more correct, twice as clear, and half as long, to show in a couple of lines that the velocity is proportional to the square root of the absolute temperature.

These minor errors will doubtless be corrected in a second edition. A. F.

Tropical Aquariums, Plants and Fishes

By A. Laurence Wells. Pp. 160. (London and New York: Frederick Warne and Co., Ltd., 1937.) 3*s*. 6*d*. net.

THIS is a very useful little book written in a popular style by an expert in keeping and rearing small tropical fishes. Mr. Wells has already published valuable guides dealing with similar subjects: aquariums and fish ponds, and garden ponds, fish and fountains. The present book will be welcomed by many, for the cult of the tiny tropical fish is rapidly increasing, and a sound practical book, simply written, is exactly what is needed, and this is what is offered. With its aid there should be no difficulty in setting up aquaria and rearing the fishes. The aquarium itself, heating, feeding, the best plants to use and how to deal with ailments, all have their share of space, but half the book is taken up with short descriptions of the various fishes themselves, their distribution, habits, the prices which they fetch and information for the treatment of each species. The book is illustrated by numerous small sketches, nearly every fish being figured and also the various plants recommended for living in the aquarium.

It might be pointed out that in describing the food certain terms are used which are rather unusual: for example, algæ as a singular noun and *Daphnæ* and *Enchytræ* as plurals.

The Alloys of Iron and Chromium

Vol. 1: Low-Chromium Alloys. By A. B. Kinzel and Walter Crafts. (Alloys of Iron Research, Monograph Series.) Pp. xv+535. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 36*s*.

THIS volume is the first part of a review and summary of published information and available unpublished data on the alloys of iron and chromium containing less than 10 per cent of chromium. The second part, now in preparation, will deal with higher chromium alloys, including the heat- and corrosion-resisting steels. The constitution of the iron – chromium and the iron – carbon – chromium systems and the effect of chromium on the critical point is first dealt with, these chapters being followed by surveys of the manufacture, treatment and properties of chromium steels and cast irons. In preparing this monograph it is stated that nine thousand papers and articles were assembled, and that of these 478 were selected for detailed study. The latter group is given as a bibliography, arranged chronologically, and will prove a very valuable feature of the book. A great wealth of data has been assembled in this volume, both in the text and in a large number of excellent tables and diagrams.

Metallography

By Dr. Cecil H. Desch. Fourth edition. Pp. viii+402+17 plates. London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 21*s*. net.

FOR twenty-eight years, Dr. Cecil Desch's "Metallography" has served admirably as a standard text-book for students of physical metallurgy, and had previously run through three editions. The last of these, however, goes back to 1922, and therefore a new and revised edition was considered desirable. This has involved the re-writing of most of the book as well as the introduction of new topics; among the latter are the improved technique of thermal analysis and of microscopic examination, the changes occurring in solid alloys (including age-hardening and the order-disorder transformation) and the processes of mechanical deformation. A section dealing with developments on the X-ray side has been contributed by G. D. Preston.

With the passing of time since this book was first published, it has become still more hopeless a task to compress into one volume our knowledge of physical metallurgy; but as an introduction and as a guide to the literature it continues to fulfil its function very well.

An Introduction to Abnormal Psychology

By V. E. Fisher. Revised edition. Pp. xiii+533. (New York: The Macmillan Co., 1937.) 12*s*. 6*d*. net.

THIS book appears in a thoroughly revised form. The lapse of only a few years necessitates much revision in an exposition of such a subject as abnormal psychology. But the author has done more than amend the first edition. He has added seven new chapters and omitted three of the old ones, doubled the number of illustrative cases, and otherwise introduced a good deal of fresh material.

The book is essentially a text-book, giving full directions for further reading, and aiming at a thoroughly comprehensive view of the whole subject. At the same time, it is interestingly written, and merits the attention of the general reader as well as that of the student of psychology.

The Basis of Tissue Evolution and Pathogenesis

By Dr. Albert A. Gray. Pp. xix+92+7 plates. (Glasgow: Jackson, Son and Co., 1937.) 7*s*. 6*d*. net.

IN this book, which is the posthumous work of an eminent Glasgow otologist, the author maintains that all tissues ultimately arise as the result of repair following injury, and supports his contention by examples of the labyrinth in animals taken from his work on the subject. He points out that the term 'injury' does not mean merely gross mechanical injury but also includes the damage inflicted by chemical agents, poisons and physical conditions, such as moisture, heat, cold, etc. He does not, however, exclude the possibility of chance variations or mutations having also played a part in the process of evolution.

A short sketch of Dr. Gray's life and work is given in the foreword by his son.

Aspects of High Polymeric Chemistry

By Prof. H. Mark

Introduction

When the magnificent structure known as organic chemistry was built up in the second half of last century, it contained not only an enormous number of new substances with interesting and valuable properties, but also embodied a series of more or less general laws on the relations between the structure and the qualities of a molecule. It was realized, for example, that the presence of certain atomic groups (OH, NH_2, HSO_3) had as a consequence solubility in water, that other combinations of atoms impressed on the molecule the property of a dyestuff, others again made it a narcotic, or an explosive, and so on. These laws did not appear suddenly in clear and definite shape, but grew slowly with the development of chemical science. They were nearly all formulated at first as preliminary rules, and their validity checked by the aid of the continually increasing experimental material. Some of them did not successfully pass this test; they are forgotten to-day and many of them are no longer known; others have survived and represent our present knowledge of the possibilities of constructing a molecule with required properties. They can be called the leading principles of preparative organic chemistry, and are of utmost value for all synthetic work in chemical industry.

At present, another organic chemistry is in full development—the chemistry of the high molecular substances. Although they are built up of the same atoms as the normal organic molecules, namely, carbon, hydrogen, oxygen and nitrogen, and only occasionally contain other elements such as sulphur, chlorine, etc., they are of incomparably higher molecular weight. While the single molecule of a normal organic substance such as benzene, urea or naphthalene has (referred to O = 16) a molecular weight of the order of magnitude of a hundred, the high polymeric bodies such as proteins, cellulose, rubber, polystyrene, polyvinylchloride, etc., achieve molecular weights of many thousands. At first they were found only in living bodies as frame-building substances and as resins; to-day we know quite a series of chemical reactions, which enable us to build them up synthetically, and they appear to be growing in importance both scientifically and technically. Almost daily a new polymerization product is built up and studied. In the chemical industry, we have to face already a host of commercial names, as neoprene, duprene, buna, perspex, victron, distrene, trolitul, mipolam, igelite, etc.

In this state of affairs, while we naturally wish to produce an increasing number of these new bodies, it is also desirable to formulate some general laws on the relations between structure and properties, unless we are to lose all control over this rapidly growing branch of chemical science. When we look back to the development of organic chemistry, we cannot expect that these laws will be at once before us in their full clearness, but they will emerge slowly from the fog, which covers the yet unknown and mysterious region of our science. Hence we are justified in putting forward some preliminary rules on the relationships between structure and properties, even although we are not yet in a position to give them the form of quantitative laws. It must always be remembered that we have to test these working hypotheses very carefully against the experimental material, and that we must give them up at once if they do not work satisfactorily.

Some Important Variables

Our actual experimental knowledge on polymerization reactions enables us to state some characteristic features for a high-molecular sample, on which the final properties of the material depend in a very important way.

(*a*) The *chemical nature* of the monomeric material; it may be either aliphatic or aromatic; it may be a hydrocarbon, an ester, a chloride or a ketone; it may contain one or more double bonds. Table 1 gives a survey of the most important materials as regards their chemical nature.

Table 1.

Chemical character of commonly used monomeric materials.

Chemical class of the monomer	Chemical formula of the monomer	Some trade names of the polymers
Hydrocarbons	Ethylene, $CH_2 = CH_2$ Butylene, C_4H_8 Butadiene, C_4H_6 Acetylene, C_2H_2 Styrol, $C_6H_5.CHCH_2$ Isoprene, C_5H_8	Oppanol Buna Victron, Trolitul Natural rubber
Esters	Vinylacetate, $C_4H_6O_2$ Acrylic ester, $C_4H_7O_2$ Methacrylic ester, $C_5H_{10}O_2$	Vinylite Plexigum Perspex
Chlorides	Vinylchloride, C_2H_3Cl Dichlorethylene, $C_2H_2Cl_2$	Igelite
Ketones	Methylvinyl ketone, C_4H_6O	
Alcohols	Vinyl alcohol, C_2H_4O	Vinarol

(*b*) The (average) *length of the main valence chains*, which form the background of every high polymeric substance. It depends essentially on the way in which the sample has been produced; whether the polymerization was carried out at low or high temperature, with or without a catalyst and so on. Table 2 provides some idea of the numbers involved.

Table 2.

Data on approximate average chain-lengths.

Material	Degree of polymerization, i.e., number of monomers in the chain
Natural rubber	approx. 500–1000
Masticated rubber	,, 50– 200
Low polymerized styrene	,, 50– 100
Medium ,, ,,	,, 200– 800
High ,, ,,	,, 2000–5000

(*c*) The *internal flexibility* of the main valence chains. According to the fundamental ideas of stereochemistry and statistics of molecular movement, a very long hydrocarbon chain has a certain amount of internal mobility due to the principle of free rotation around the single main valence bonds. This mobility can be reduced by substituents, double bonds, ring formation, etc. Table 3 gives some examples of this property.

Table 3.

Data on the Flexibility of the Chains.

Material	Internal flexibility of the chains
Cellulose	Very low
Cellulose esters	Very low
Polystyrene	Fairly low
Polyvinyl chloride	Fairly low
Methacrylic ester	Rather low
Acrylic ester	Medium
Polyvinyl alcohol	Medium
Polyisoprene	High
Polybutadiene	Very high
Polybutylene	Very high

(*d*) Main valence *linkages between the chains*. In certain cases, especially when the monomeric molecule contains more than one double bond, it is possible to create cross linkages between the long chains. This strengthens greatly the whole structure of the resin, makes it resistant to heat, impact and abrasion, but, on the other hand, increases the density and decreases the flowing properties. This 'netting' of the chains may be quantitatively characterized by the 'netting index' (*Vernetzungszahl*), which indicates the number of cross linkages to a hundred chain linkages. A netting number of 3 would mean that in the sample we have on an average three bonds perpendicular to the chains to a hundred parallel to them. Table 4 gives an idea of the amount of netting in different materials. It must be pointed out that, in accordance to the preliminary state of the whole of our quantitative knowledge in this field, all figures have to be taken as very rough estimations, but nevertheless they form a useful basis for further and better work.

Table 4.

Data on Cross Linkages between the Chains.

Substance	Amount of cross linkages (netting index)
Native cellulose	Nearly zero
Native rubber	Nearly zero
Polybutylene	Very low, ~ 3–5
Polystyrene	Very low, ~ 3–5
Polyvinyl chloride	Very low, ~ 3–5
Soft rubber	Medium, ~ 5–10
Polybutadiene	Medium, ~ 5–10
Hard rubber	High, ~ 10–20
Buna	High, ~ 10–20
Bakelite	Very high, ~ 50

Connexion between Structure and Properties

After having enumerated some of the important factors, which together characterize in some way the structure of a high polymeric material, we may try to sketch some connexions between these factors and some of the more interesting technical qualities. For the present short survey, we choose the following properties: heat, oil- and water-resistance, impact and abrasive strength, electrical resistance and reversible elasticity. There are others, which may be equally important; for example, the flowing properties, the surface hardness or the dielectric constant, but it would be inappropriate here to deal with them all. For the sake of simplicity, it must suffice to state the results which one can derive from our present experimental knowledge together in a short table, without discussing every one of them in detail (Table 5).

At the top of the table, the different properties are named, and in the columns the four variables above-mentioned, namely: (*a*) chemical nature of the monomeric molecule; (*b*) length of the chains; (*c*) flexibility of the chains; (*d*) netting number. Two crosses mean that this particular variable has *no effect* on the special property at all; one cross indicates that it has *little effect*; if there is any effect it is stated in words.

We see, for example, that the impact strength is decreased by a small netting number and increased by a large netting number, that the water resistance is lowered by the content of OH and OCH_3 groups and made bigger by the introduction of CH_3 groups or fatty radicals, but that it is not affected by the chain length at all.

It is easy to see how such a survey can be used. Let us assume we want a material with high heat-, water- and electrical-resistance and great impact strength. Then we shall take a hydrocarbon with long chains (whether they are flexible or not is immaterial) and strong netting. If we want a rubber-like material, we have to make use of very long and flexible chains without too much netting. If it is to be oil-resistant we shall try to avoid

CH_3 groups in it, and we find that, as regards the flexibility and the netting number, the two qualities of oil resistance and high reversible elasticity require opposite factors. Then it will depend on whether oil resistance or high elasticity is more important, and the choice will fall on a netting number in favour of the more valuable quality. In the case of artificial rubber, for tyres, for example, the range of reversible elasticity must not be very high (about 100 per cent) but abrasive strength and oil resistance are so important that one would prefer a considerable amount of netting, as is indeed the case in all synthetic materials used for this special purpose, as neoprene, buna, sowprene or thiokol.

It is easily realized how many possibilities for building up substances of very interesting properties are already available in such a rough and unexact scheme as Table 5 represents. Nevertheless, it must be pointed out very clearly that it is absolutely necessary to work out every single case very carefully, and to weigh against each other all the required properties and possible results.

TABLE 5.

RELATIONSHIP BETWEEN STRUCTURE AND PROPERTIES OF HIGH MOLECULAR POLYMERS.

Heat resistance		Oil resistance		Water resistance		Impact strength		Abrasive strength		Reversible elasticity	
decreased	increased	decreased	increased	decreased	increased	decreased	increased	decreased	increased	decreased	increased
(*a*) ×	×	by CH_3, OCH_3 and fatty groups	by OH groups and O-bridges	by OH, NH_2, OCH_3 HSO_3, COOH groups	by CH_3, C_6H_5 and fatty groups	×	×	by CH_3 or fatty groups	by OH groups	×	×
by (*b*) short chains	by long chains	×	×	×	×	when chains are short	by long chains	by short chains	by long chains	by short chains	by long chains
(*c*) ××	××	by very flexible chains	when chains are not too flexible	when chains are very flexible	by rigid chains	×	×	×	×	by rigid chains	very much by flexible chains
(*d*) low netting index	very much by high netting index	by low netting index	very much by high netting index	when netting index is very low	by high netting index	by low netting index	very much by high netting index	by low netting index	very much by high netting index	very much by high netting index	by low netting index

At the present time, it is not possible to write down mathematical expressions for the relations between structure and properties of high polymeric substances, but it is possible to derive some preliminary and imperfect rules, which will help us to find our way in this new and very promising field of modern chemistry.

An African Survey*

THIS great survey of the problems of Africa south of the Sahara carried out by Lord Hailey originated in a suggestion made by General Smuts in his Rhodes Lecture at Oxford in 1929, when he pointed out that Africa was developing under the control of a number of European powers, that different, and often conflicting principles were being applied in the administrative, social, educational and legal fields, but that nowhere was there any survey of what was taking place in Africa as a whole. His plea for a survey of the extent to which modern knowledge was being applied to African problems was met by the appointment of a committee consisting of Lord Lothian as chairman, Prof. Henry Clay, Prof. Reginald Coupland, Mr. Lionel Curtis, Sir Richard Gregory, Prof. Julian Huxley, Mr. Ivison Macadam, Dr. J. H. Oldham, Sir John Orr and Sir Arthur Salter, with Miss Hilda Matheson as secretary. The funds for the survey were chiefly provided by the Carnegie Trustees and later by the Rhodes Trust.

In 1933, Lord Hailey accepted an invitation to undertake the survey, but was unable to undertake personal work until 1935, though certain preliminary inquiries were set on foot in the meantime. It was intended originally that the scope and form of the report—the conception of Lord Hailey—should be of a general character only; but as a result of a year's journey through Africa from the Cape to the Sahara, in which a distance

* An African Survey: a Study of Problems arising in Africa south of the Sahara. By Lord Hailey. Issued by the Committee of the African Research Survey under the auspices of the Royal Institute of International Affairs. Pp. xxviii+1838. (London, New York and Toronto: Oxford University Press, 1938.) 21*s.* net.

of 22,000 miles was covered, and information was sought and obtained from every possible source, it became evident that the original conception must be much enlarged. In the preparation of the report, chapters dealing with special topics were prepared and the more important then circulated among the Colonial and other Governments concerned, as well as among authorities working on these topics, from whom additions and comments have been received.

The Committee believes, in the words of Lord Lothian, "that this volume will mark a new era in the history of the continent—because it will enable those who are responsible for policy to consider it in the light of the problems of Africa south of the Sahara as a whole".

The method of approach is objective and factual. In addition to discussing the state of our knowledge of the problems of the development of Africa, it describes the physical and social background out of which they have arisen, and analyses the factors which must determine their solution. Hence the early chapters of the report after introductory matter deal with the physical background, survey and mapping, climate and vegetation, climatology and meteorology, as well as the African peoples, their divisions and institutions and languages and the agencies for their study, at the same time pointing out deficiencies in method and scope.

While Africa has a larger proportion of tropical area than any other continent, from the human aspect its most striking feature is the fact that with the exception of Australia it has the lowest density of population in relation to its area. The first of these facts has a special significance in relation to the extension of European settlement in Africa; the second seems to be connected in some measure with the existence of known deficiencies in the constitution of the soil and with the prevalence of diseases facilitated by the malnutrition associated with such deficiencies. This fact gives special importance to the necessity for a scientific approach by the African Governments to the interrelated problems of agriculture, animal husbandry and health.

A great number of areas in Africa still await topographical survey sufficient for the mapping needed for the handling of social problems and the work of material development. It is, however, first necessary to supply an adequate geodetic framework on which a successful topographical survey must rest; for the arc of the 30th meridian, begun at the Cape early in the century on the advice of Sir David Gill, has not yet been completed.

In dealing with the study of the African peoples, for purposes of description the conventional classification of Bantu, Hamitic and Negro is adopted. There is no anthropological survey which would make possible a classification of tribes on the basis of physical characters. For present purposes, however, it is felt that a study of racial origins is of less importance than that of the reaction of African cultures to the influence of European civilization; and that the social anthropologist can fulfil a practical function by providing material which will enable the African Governments in directing their own policy to see that the process of adjustment to new conditions shall cause as little disturbance as possible to African society. Anthropological study has a further relevance in so far as observations made on African social life may be able to throw light on the existence of a characteristic African mentality. The view here taken is that African social conceptions do not necessarily indicate any intrinsic difference of character or mental capacity between them and other peoples. Neither the examination of the brains of Africans as indicative of mental capacity, nor intelligence tests, have as yet furnished any conclusion which will assist in the determination of general administrative policy.

The diversity of native languages, taken as seven hundred in number, constitutes a problem of special difficulty, particularly when policy has determined that education shall be given in the vernacular. It is necessary in such cases to determine whether the language chosen shall be a dominant vernacular or a lingua franca such as Swahili. It is a question whether either the African Governments or commercial firms attach sufficient importance to the attainment of linguistic efficiency by their servants.

Great differences exist as between estimates of the indigenous population of Africa. Expert authority now limits itself to the view that the present total may lie between 138,100,000 and 163,300,000—in itself, it is remarked, commentary on the value to be attached to the present system of enumeration. It is thought probable that the African population is either stationary or subject to a very slow increase. The desirability of a more efficient system of enumeration is shown by the difficulty of checking many current assumptions on such matters as the extent of infantile mortality, and the effect on the birth-rate of African marriage customs. A system of registration of births and deaths might be introduced in all areas where there are means of securing reasonable accuracy.

Having dealt with natural conditions and the people, the report then turns to their relations with, and position under, European authority.

In the matter of policy, the presence of a considerable European element in some of the British territories gives rise to consideration whether the

prevailing policy of indirect rule is compatible with the ideal of self-government by representative institutions, and whether native institutions must not be materially modified, if they are to be made to fit into any scheme involving an elected parliament. The objective of South Africa and Southern Rhodesia—the preservation of the social and economic standards of European civilization—leads to the policy of segregation, in which in the Union access is provided to a consultative body, the Natives Representative Council, and not the South African Parliament. French policy does not envisage a future self-government, but development which will fit a colony to occupy in reality the position now assigned to it in principle as an integral part of France. Emphasis is not on securing a growing measure of political rights, but on progressive access to French culture and legal institutions. The main source of legislation is the ministerial decree and executive devolution, a concession to the influence of personality rather than to principle. In the Belgian colonies the policy of material development is combined with a conscientious recognition of the need for safeguarding the conditions of labour, promoting health organization, and improving the means of subsistence.

Careful consideration is given to the question of labour. The normal economic incentive is now an influence of increasing strength. Labour problems are due to shortage of the local supply, rather than a disinclination to enter wage employment.

In relation to the land, the communal system of landlord holding prevails over the greater part of Africa, and it would be premature to give legal recognition to individual titles; but it may be necessary before long to undertake this process in economically advanced areas.

In the use of the land at an earlier stage in the history of the agricultural departments, attention was largely directed to finding means for increasing the production of export crops. Of late years, a variety of causes has tended to emphasize the need for improvement of native subsistence crops. Native agriculture is for the most part based on the system of shifting cultivation, a natural adjustment to the needs of African soils, which require a considerable period for regeneration after cropping. The settlement of population in fixed areas and pressure on the soil due to the expansion of economic crops have led to the use of the system in an abnormal manner, with the result that the period of regeneration is unduly curtailed and the vegetal cover destroyed. As regards animal husbandry, the salient facts are that over a large part of Africa the tsetse fly makes it impossible to keep domestic cattle, and in other large areas the semi-religious value attached to cattle leads to overstocking, which is liable to cause great destruction of pasture and to produce soil erosion.

The first effort towards the improvement of native agriculture must be to indicate an alternative method for the regeneration of soil after cropping, of which one of the most promising examined appears to be mixed farming. Its success, however, will depend upon the efforts made to secure protection from the tsetse fly, and to secure a more economic use of cattle by the natives elsewhere. Although native methods of agriculture are rooted in custom, past experience shows that new methods will be accepted if these can be demonstrated to be adapted to their circumstances. Every effort should also be made to secure the co-operation of the Africans themselves in the preservation of their woodlands. It is clear that erosion, a major problem, in so far as it is caused by shifting cultivation and by overstocking, has been accelerated by modern conditions, under which populations are concentrated, more extensive areas of land are cultivated, and the increase of stock is more rapid.

Problems of health are obviously of much importance, but there are no reliable statistics which would enable a comparison to be made between Africa and other territories in respect of the prevalence of disease. The fact remains, however, that malnutrition is a characteristic feature of many parts of Africa; there are low standards of hygiene in many rural areas and in most urban native locations, and there is a marked prevalence of malaria, sleeping sickness, venereal disease and different forms of helminthic disorders. The task of the health services in Africa extends beyond the application of modern scientific technique for the prevention and cure of disease; they share in the responsibility for other social services for the improvement of African conditions of life. Their part is the more important, because they are concerned with some of the fundamental problems of Africa, such as that of nutrition.

Only of recent years has systematic thought been given to the form which native education should take in Africa. At an earlier stage in the Union, official opinion would have given to the African only the instruction suitable for those whose future lay in subordinate positions in European employment. A change came with the recognition by the Governments that education must be extended progressively throughout the population. As a result the educational system in the Union is now coming under revision. Current policy seems to indicate the vernacular as the most suitable medium for popular education both in the Union and in the British Colonies,

where an effort is being made to give school courses a content suitable to African environment. But native education is still in its initial stages and the wider employment of Africans in the public services is delayed, owing to the lack of candidates fit to receive special training for their work. The most pressing need in regard to popular education in British territories appears to be better means of control and improved standards of teaching. The future of advanced education must remain in some doubt until the Government arrives at some definite policy on the position which the native is to occupy in the administrative and technical departments, particularly under a system of indirect rule. In the French possessions, education forms an essential feature in the policy of 'association'. A carefully devised system separates the *élite* from the mass, giving the former a training which engages their sympathy with French culture and makes them efficient auxiliaries in the work of administration. The chief characteristic of the Belgian system is its effort to improve the African's capacity for the work of developing the Congo.

In discussing the internal and external aspects of economic development, the report has much interesting material for consideration, and makes the pregnant deduction from current tendencies, that in the future the European may move away from general agriculture into commerce or various forms of non-agricultural enterprise.

On the other hand, the future economic prosperity of some of these countries probably depends more upon the general development of native economic activity than on the results of European enterprise. The African, however, cannot achieve his economic development without a material change in his present social customs.

We see before us now the most formative period of African history. Much that is done to-day will have a decisive effect on the future of the African peoples. The task of guiding the material and social development of Africa gives rise to problems which cannot be solved by the application of routine knowledge; they require a special knowledge, which can only be gained by an intensive study of the unusual conditions. This study must be pursued in the field of the social as well as the physical sciences. For this purpose assistance is required from the Imperial Government. This should take the form of a grant to be administered either by a Committee of the Privy Council or by the Economic Advisory Council. Further, the difficulty which is now felt in readily securing information about Africa should be met by the establishment of an African bureau covering social, economic, scientific and administrative problems, which will constitute both a clearing house for information, and a source of assistance to aid all those who are pursuing research or inquiry into African questions.

Czechoslovakia's Contributions to Science: A Survey and a Forecast

By Dr. Gerald Druce

WHEN the Czechoslovak State regained its independence in 1918, the people looked forward to a period of fruitful constructive effort in industry, education, culture and science. Despite a long period of subjugation, the nation could look back upon a tradition in the field of science and learning. The University of Prague, the oldest in Central Europe, was founded in 1348, and during the Middle Ages, the natural sciences flourished in Bohemia, as is shown by the number of herbals and contemporary mineralogical and alchemical works in the Czech language.

With the defeat, in 1620, of Frederick, the elected king of Bohemia and son-in-law of the English monarch, Bohemia not only lost its independence but also an end was put to all cultural and scientific activities for more than a century. Practically all Czech publications had then to be printed in Poland, Holland and certain German States. The University was handed over to the Jesuits, who combined it with their college, which had existed since 1556. It was re-named the Charles-Ferdinand University; German gradually displaced Latin as the language of instruction. Science was scarcely taught, and although Adam Zalužanský in 1604 had insisted that botany, for example, should be considered a separate subject, what courses there were covered all the sciences. Among the few distinguished professors was Jan Bohač (Bohadsch), but, even his comprehensive "Flora, fauna et historia regni lapidei Bohemiae" remained in manuscript. When he died in 1768, the science chair remained vacant until 1775, when his pupil, Zauschner (who re-discovered the *Gagea Bohemica* described by Jan Cerny in the fifteenth

century), gave some lectures on natural history. His successor was J. G. Mikan, a medical man who lectured mainly on chemistry.

A cultural revival first became possible towards the beginning of the nineteenth century, when certain noblemen with a feeling of local patriotism became patrons of science. Thus, through the efforts of Count Ignatius Born, the Bohemian Scientific Society was founded in 1775. This society interested itself primarily in the study of local flora, fauna and minerals, but later turned its attention also to mathematics, astronomy and physics. Count Malabaila Canal, a foreign resident in Prague, laid out a garden for the cultivation of economic plants and founded an institute for lectures in botany to be delivered by distinguished Czech botanists. These were given for more than thirty years, but ceased when Count Canal died in 1826.

Science found its strongest supporter, however, in Count Kaspar Sternberg, the centenary of whose death falls this year. He was himself a botanist and palæontologist and the author of many scientific works; but his greatest achievement was the founding of the Bohemian National Museum in 1818. To this he not only presented his own extensive collections but also he impoverished himself to purchase books, minerals and herbaria from others, especially Czech collectors whose expeditions abroad he sometimes financed. He also liberally supported the scientific periodical, *Krok*, which appeared between 1820 and 1840 under the editorship of J. S. Presl, who published in Czech much contemporary scientific work.

The National Museum was important because it developed an interest in science, though after Sternberg's death it widened its scope to become the rallying point of all Czech culture. Nevertheless, this was a period when Bohemia possessed a number of famous biologists, such as the brothers Presl, A. J. Corda and F. M. Opiz, all of whom made contributions to the advancement of botany, whilst A. Frič and J. E. Purkyně became famous zoologists. The University could not escape the effects of the national revival movement, and outstanding personalities like Purkyně lectured in Czech, despite official disapproval. Eventually, in 1882, the University was divided into the Czech Charles University and the German (Ferdinand) University, which retained most of the buildings and possessions.

Despite difficult circumstances, the Czech professors soon began to make valuable contributions to the natural sciences. The first modern chemist was Stolba, who was followed by Brauner, but only after persistent pleas was the new Chemical Institute erected in 1903, largely on the strength of Brauner's international reputation from his work on the rare earths and atomic weights. A few other institutes, for example, for physics and botany, were eventually built, but the more specialized branches of science had to wait until the establishment of the republic before they had more than improvised accommodation.

A number of chemists, Štěrba-Böhm, Heyrovský, Tomiček and Křepelka, have followed some field of chemistry initiated by Brauner. In physics, F. Kolaček was a pioneer in electromagnetism and the physics of the ether and V. Posejpal contributed to a number of topics, including the refractivity of gases at low pressure. K. V. Zenger was famous for his work on solar meteorology, and mineralogy (especially local) was developed by F. Slavík, who has frequently collaborated with British authorities. In biology, Purkyn had been followed by Sachs. Then came F. L. Celakovský, who laid the foundations of plant physiology (in which he has been ably succeeded by B. Němec), and upheld the view that floral members are modified leaves. In systematic botany, K. Domin has continued in the tradition of foreign expeditions, notably to Australia, India and the West Indies, whilst J. Velenovský's work on fungi is a classic in that field.

Many notable advances have been made by Czechs other than those associated with the Charles University. The researches of Stoklasa and of Votoček and their collaborators was, for example, done at the Polytechnic, and the other universities and institutes have also contributed to scientific knowledge.

The German University, after the division of 1882, concentrated mainly upon the study of German literature. Nevertheless, work of permanent scientific value has been carried out by Rothmund in physical chemistry, E. F. Freundlich in astronomy, Waldschmidt-Leitz in microchemistry, E. G. Pringsheim and V. Czurda in plant physiology and M. Stark in mineralogy. The German University served the German-speaking community of Czechoslovakia and also attracted students from abroad. Now that the country has lost the territory from which its students came, its *raison d'être* has largely disappeared. It has been reported that the German University will continue with support from Germany, but this seems doubtful, since those professors with Nazi sympathies have left. The others include some who cannot be regarded as Aryans. Another proposal is that the University should move to Reichenberg (Liberec) or some other town in the ceded territory, but this proposal, also, has its difficulties.

Their liberation in 1918 did not blind the Czechs to their obligations towards the other nationalities within their frontiers, and adequate provision was made for them in elementary, secondary, and

technical schools, whilst the Germans in Czechoslovakia were the only minority to possess a university of their own. Indeed, in some ways the minority was more fortunate than the Czechs, for at the German University there was one professor for every forty students, whereas at the Czech University the ratio is one to forty-eight.

Altogether, the republic possessed some twenty-eight institutions of university rank. Advanced science teaching and original work is carried on at the universities, the polytechnics and at various special schools, such as that for mining at Příbram, the Brno veterinary college, and at forestry schools and institutes for glass technology. All have hitherto enjoyed generous support from the State. Moreover, a number of industrial undertakings have fostered specialized research work. Among these must be included the Radium Institutes of Prague and Jáchymov, the research laboratories of the Chemical Union, and those of the sugar industry, the leather trade, the forestry commission, the agricultural society and even much of the horticulture at Blatna is work of a scientific character.

As has been said before (see NATURE, Oct. 8, p. 637), various scientific and cultural institutions at Jáchymov (St. Joachimsthal), Usti (Aussig), Liberec (Reichenberg) and Opava (Troppau), to mention some of the more important ones, go with lost territory. These may still be utilized for local needs, but they are lost to Czechoslovak culture and science. More serious than this loss will be the curtailment of revenue without any compensating reduction of State liabilities, and it is obvious that the mutilated republic cannot continue to support its scientific and other educational institutions on the same scale as hitherto. A forty per cent 'cut' is to be made in the budget of the ministries, and it is to be feared that research and science will feel the full force of this necessity. The outlook for university staffs and the research workers is anything but reassuring. Amalgamations and the closing of minor institutions seem inevitable, and indeed this has already commenced.

The outlook for Czech scientific societies and publications is also serious. With diminished scope and reduced resources, many societies and their journals will find it difficult to continue unless they are able to secure assistance from abroad. Meanwhile, throughout the anxious weeks of uncertainty and national disaster, the university staffs, school-teachers and public officials have shown a remarkable courage, self-denial and discipline although for them, each and all, the future holds no security. A nation that has survived previous cultural and national disasters, coupled with persecution, will not lightly give up the struggle for a better future. First efforts must be directed towards economic survival. When this is vouchsafed, it will again be possible for men of science to continue in the traditions of their distinguished predecessors.

Obituary Notices

Miss Clotilde von Wyss

BY the death on November 7 of Miss Clotilde von Wyss, the world of education has lost an outstanding teacher of natural history, distinguished by her philosophical outlook and by her sympathetic attitude towards living things.

Clotilde von Wyss was born in Switzerland in 1871, and received the earlier part of her education at a school in Zurich, but from 1884 until 1891, she was a pupil at the North London Collegiate School. She was trained as a teacher at the Maria Grey College, Brondesbury, and after her course there gained distinction in the Cambridge Teachers' Certificate. From 1894 until 1897, she taught at St. George's High School, Edinburgh, and during that time she was an external student at the Heriot-Watt College, coming under the influence of the distinguished naturalist, J. A. Thomson, then a lecturer in the University. Miss von Wyss valued this experience extremely highly and always spoke of the late Sir Arthur Thomson with the greatest affection and esteem. From 1897 until 1900 she taught biology at the North London Collegiate School, after which she was a lecturer at the Cambridge Training College for Secondary Teachers. In 1903, she joined the staff of the London Day Training College, and here for thirty-three years she was a successful and stimulating lecturer in natural history and hygiene and a highly valued colleague.

Miss von Wyss was a brilliant and inspiring teacher. She had a wide knowledge of natural history and an infectious enthusiasm for the educational principles which she upheld. She never lost sight of the interdependence of theory and practice, and after the free and friendly discussion of school problems that prevailed in her classes, her students went out to teach with a feeling of power and confidence. She had a delightful personality, a lightness of touch and a sense of humour which helped her in surmounting difficulties and affected even the most unpromising students. Teachers of many years standing still remember her with affection and

gratitude, and one of them writes, "even now her advice and criticism form the sheet anchor of my everyday teaching practice". Her ideals and personality have influenced many generations of students and she herself once said, "My family must number some thousands". These are to be found, not only among old students of the London Day Training College, latterly the Institute of Education (University of London) but also amongst the many London teachers who attended her evening classes organized by the London County Council.

Miss von Wyss was not only a successful lecturer but like all true teachers she was also continually a learner. Her observations and practical knowledge of wood-ants (*Formica rufa*) were used in 1936 by the Gaumont British Film Corporation in constructing a film, which not only in the spoken commentary but also in the details of the ant-life shown is both artistic and educational.

Convinced as she was of the value in education of the study of Nature along sound lines, Miss von Wyss helped in 1903 to found the School Nature Study Union, which stands for the sympathetic and first-hand study by the child of its natural environment, particularly of plants and animals. From 1906 until 1936, she was editor of the quarterly journal brought out by the Union, and the diversity and usefulness of the articles that have appeared during that time may be realized from the list of leaflets published by the Union, about seventy of which are reprints from *School Nature Study*. As a colleague on the executive committee of the Union, Miss von Wyss was invariably tactful and courteous; her opinions were always appreciated because they showed careful thought and sound judgment and on many occasions it was her intervention which cut the Gordian knot of a seemingly hopeless tangle.

Miss von Wyss has also played an important part in the wider sphere of influence which comes under the auspices of the B.B.C., and her gift of the power of presenting knowledge in a simple and interesting manner has enabled her to carry her message into schools untouched in any other way. She spoke and wrote with ease and clarity, and her views are to be found in many articles in educational publications and notably in her books, "Living Creatures", "The Teaching of Nature Study" and "The Elements of Biology".

Miss von Wyss will long be remembered as an inspiring teacher, an able and courteous colleague and a great pioneer in the school teaching of elementary biology. R. F. S.

Prof. Leonard S. Dudgeon, C.M.G., C.B.E.

Prof. Leonard S. Dudgeon, who died on October 22, aged sixty-two years, was educated at University College School, London, and entered St. Thomas's Hospital Medical School in 1894. After qualifying, he decided to devote himself to pathology, and was appointed clinical pathologist to St. Thomas's Hospital in 1903. Here he gained an extensive knowledge of morbid histology under the late S. G. Shattock, with whom he collaborated in several investigations, and whom he succeeded as lecturer in pathology to the Medical School.

During the Great War, Dudgeon served as temporary colonel, A.M.S., in the Near East, and was consulting pathologist to the Expeditionary Force in the Balkans, being mentioned three times in dispatches. At the conclusion of the War, he returned to St. Thomas's, continued his pathological work, and on the retirement of Sir Cuthbert Wallace in 1928 became dean of the St. Thomas's Hospital Medical School, and later chairman of the Hospitals Deans' Committee and a senator of the University of London.

Although he contributed a number of investigations, Dudgeon was first and foremost a practising pathologist, and was never so happy as when applying his pathological knowledge in the elucidation of problems of diagnosis and treatment of obscure morbid conditions. One of Dudgeon's earliest investigations, published in 1906 in collaboration with P. W. G. Sargent, was on the bacteriology of aseptic wounds, which showed that microbes of the *Staphylococcus* group are of frequent occurrence in wounds that heal without suppuration. This subject was expanded in the Horace Dobell Lecture delivered to the Royal College of Physicians in 1908. Two or three other papers upon the staphylococci were published jointly with workers in his laboratory, dealing with the classification of members of this group of microbes by means of cultural, agglutination and other tests. Another subject upon which he published several papers was that of *Bacillus coli* infections of the urinary tract. He showed that two types of *B. coli* occurred in these conditions, one hæmolytic the other not, and tested the value of vaccine and other treatment upon them. He was also interested in infections of the intestinal tract, derived doubtless from his experience in the Balkans, and he made a considerable study of the bacterial flora of the human intestine under normal and abnormal conditions.

Various studies upon problems of immunity were also carried out by Dudgeon. With Shattock, he investigated the phenomena of phagocytosis in human blood-serum when this was mixed with horse-serum, and later on phagocytosis carried out with melanin particles, in which they showed that phagocytic cells vary as well as the serum. Dudgeon also investigated the presence of hæm-agglutinins, hæmopsonins and hæmolysins in the blood obtained from cases of infectious and non-infectious diseases in man, and he brought together his studies on immunity in the Croonian Lectures delivered to the Royal College of Physicians in 1912. Blackwater fever, pathological changes in the tissues in acute diphtheritic toxæmia, the action of bile and bile-salts on animal red blood-corpuscles, and the reactions of the tissues and cells of the rabbit to injection of *Staphylococcus aureus*, a pathogenic agent, as compared with inert particles such as indian ink and colloidal silver, were other subjects investigated by Dudgeon, either alone or jointly with others.

R. T. H.

News and Views

Cleveland Abbe (1838–1916)

On December 3 the centenary occurs of the birth of the eminent American meteorologist and astronomer Cleveland Abbe, whose work at Cincinnati Observatory led to Congress passing the Act of 1870 authorizing the creation of a United States Government Weather Service and placing it under the Signal Branch of the War Department. Abbe took a prominent part in the organization of the new bureau and for forty-five years, from 1871 until 1916, was professor of meteorology and senior scientific assistant to the Chief Signal Officer. Abbe was born in New York on December 3, 1838, and graduated from the College of the City of New York in 1857. As a student he had studied Ferrel's work and this led him to a close examination of the meteorological papers then published. On the outbreak of the Civil War he enlisted, but served only for a short time on account of his nearsightedness. He then turned to astronomy, and worked at the observatories at Cambridge, Mass., Pulkovo and Washington. In 1868 he was appointed to the directorship of the Cincinnati Observatory in Ohio, holding this position until 1873. The list of his writings on both astronomy and meteorology is a very long one and includes "Studies in Storm and Weather Forecasting", "Mechanics of the Earth's Atmosphere" and "Physical Basis of Long Range Forecasting". His influence on the progress of meteorology in America was outstanding, and his work received recognition both at home and abroad. He was made a fellow of the Royal Astronomical Society in 1876, and in 1912 the Royal Meteorological Society awarded him the Symons Medal. He died at Chevy Chase, Md., on October 28, 1916.

New International Standard for Vitamin B_1

It is announced that the first International Standard for Vitamin B_1, which consisted of an adsorbate of the antineuritic vitamin, made from rice polishings, on fuller's earth, has now been replaced by a preparation of crystalline vitamin B_1 hydrochloride. In recent years, progress in the study of the antineuritic vitamin has been rapid, and this change in the form of the international standard has been made possible by the synthetic preparation of the vitamin in pure crystalline form. Through the generosity of four manufacturers, an adequate quantity of the new crystalline material was placed at the disposal of the National Institute for Medical Research, Hampstead, to enable a new standard to be prepared consisting of the pure crystalline substance. Extensive international investigations of the properties of this material, and, in particular, the determination of its potency in terms of the original international standard by a variety of methods, have now been completed, and the members of the International Conference on Vitamin Standardization have unanimously recommended that the sample be adopted as the Second International Standard for Vitamin B_1, and that the international unit be defined as the antineuritic activity of 3 micrograms of the international standard preparation. This recommendation has been adopted by the Permanent Commission on Biological Standardisation of the Health Organisation of the League of Nations.

As in the case of the other international vitamin standards, the new standard for vitamin B_1 is held, on behalf of the Health Organisation of the League of Nations, at the National Institute for Medical Research, London, N.W.3, and is distributed therefrom to national control centres established in other countries for local distribution to laboratories, institutes and research workers; and to workers resident in countries in which the establishment of national control centres has not yet been completed. With regard to the supply of the new standard for vitamin B_1 to those requiring it in the United Kingdom, samples have already been sent to the laboratories, institutes and research workers who have hitherto received the standard adsorption product. Others requiring the standard are asked to make application to the Department of Biological Standards, National Institute for Medical Research, London, N.W.3.

National Association of Science Writers

The National Association of Science Writers, of Washington, D.C., has been awarded the second annual Clement Cleveland Medal of the American Society for the Control of Cancer "for outstanding work during the year in the campaign to control cancer". The medal was established last year by Mrs. Robert G. Mead in memory of her father, Clement Cleveland. The late Dr. Cleveland was one of the pioneers in the medical profession on public education for cancer control, and it was in his New York home that the American Society for the Control of Cancer was organized in 1913. The award of this medal to the National Association of Science Writers is a fitting recognition of the work of this group of American journalists in promoting accuracy as well as intelligibility in dealing with scientific topics in the Press. The Association is a comparatively young body, and the fact that the award was made for work in connexion with a notoriously difficult subject, which is often the subject of exaggerated claims, enhances its value. It is interesting to note that Mr. J. G. Crowther, well known for his contributions on scientific topics to the Press in Great Britain, has been elected an associate member of the Association.

Blind Landing System at Aerodromes

It is reported that 40 R.A.F. aerodromes are now to be equipped with blind-landing approach apparatus. This will presumably be the Lorenz system, already in use at Croydon, Heston and Manchester civil aerodromes, and extensively on the Continent, particularly in Germany. In principle, it consists of a wireless beam along and down which the machine flies as it approaches the radiating station, on or near to the aerodrome. The waves are picked up by the aircraft's apparatus, and turned into signals arranged so that they give warning to the pilot of any deviation of his from the line of approach, both in regard to his angle to the earth and in a horizontal plane. A further warning is given when it is necessary to flatten out preparatory to landing. The adoption of such a system will facilitate the operation of bomber squadrons in bad weather conditions. The presence of low cloud, mist or fog, is often an advantage to bombers when attacking, in that it helps to screen them from fighter and ground defences. It is obviously important that they should be independent of these conditions when operating from their home aerodromes. The fact that these facilities may be available in emergencies for civil aircraft, should encourage a more general adoption of the system in civil aviation, which will help to promote both safety and regularity in service in civil air transport.

Early Races of the Far North in America

Dr. Aleš Hrdlička, of the Smithsonian Institution, Washington, having completed his tenth summer season of archæological and ethnological investigation in high latitudes, has brought his exploration of the far north of the American continent to a close, and is now engaged in the examination of the skeletal remains of the Aleutian and pre-Aleutian peoples, as well as of the specimens of the material culture of the latter, collected in the last three years. Dr. Hrdlička gave a summary of his results in his annual Smithsonian lecture, which was delivered in the auditorium of the New National Museum, Washington, on November 8. He then pointed out that when he entered upon this investigation ten years ago, it was supposed that only two peoples lived in this part of the globe, the Eskimo with the Aleut and the Indians. Now six races are recognized. There are two distinct types of Indians and two types of Eskimo, while it is established that the Aleut are distinct from the Eskimo. The most interesting discovery made by Dr. Hrdlička is, however, the sixth race, the pre-Aleut people, whom he regards as close to the Shoshonean and the Californian Indian. Some of them, though not all, practised mummification, and it may be that the Aleut followed them in this practice, as in a few places mummies of the two races have been found together. The remains of the older people, the pre-Aleuts, show close affinities with the peoples who were discovered in the lowest levels of the old village site on Kodiak island; but whereas those peoples appear to have been exterminated in a great slaughter, the pre-Aleuts appear to have escaped this fate, although as a distinct people they have disappeared. The evidence which has been gathered points to the pre-Aleuts having reached these islands from Alaska, whither their ancestors had migrated at a very much earlier date from Asia. Dr. Hrdlička dates their coming to the Aleutians at approximately two thousand years ago.

Recent Accessions to the British Museum

Among recent additions to the ethnographical collections of the British Museum (Bloomsbury) announced at the November meeting of the Trustees, were four loans by the King from the Royal collections. Of these, one is a war drum carved from the trunk of a tree, with human skull attached, taken from the King of Ashanti at his defeat in 1826 and presented to George IV; and a Maori chief's staff of office, a combined spear and club, which was presented to Queen Victoria by Maori chiefs in 1884. The National Art Collections Fund has purchased for the Museum a gold Persian wine-bowl of the eleventh or twelfth century, having a Kufic inscription around the rim in praise of wine, and an ornamental design in which several realistic representations of ducks are a prominent feature. Among other gifts are a collection of antiquities, including small bowls, dishes and scarabs of the Eighteenth Dynasty (*c.* 1370 B.C.) from the excavations of the Egypt Exploration Society at Sesebi in the Sudan, given by that Society; a small finely carved Egyptian lion of ivory, probably dating from the First Dynasty about 3300 B.C., given by Mr. and Mrs. Alec Rea; and a bronze head of a Pharaoh, probably Ptolemaic, given by Lord Harlech; while Mr. Reay Geddes has deposited on loan an Indian sculpture in stone of the eleventh or twelfth century, which represents Agni, the god of fire, surrounded by worshippers and goat-headed attendants. Mr. Alvan T. Marston, with the consent of the Portland Cement Manufacturers, Ltd., has presented to the Trustees the Swanscombe skull and the bones and implements associated with it. The skull and some of the implements have been allotted for exhibition at the British Museum (Natural History), while the remainder are to be exhibited in the archæological collections at Bloomsbury. These implements have been pronounced to be Early Middle Acheulean, Breuil's Acheulean III.

Portrayal of Weather in Art

The *Quarterly Journal of the Royal Meteorological Society* for October contains a valuable paper by Mr. L. C. W. Bonacina on "Turner's Portrayal of the Weather". Landscape features and weather are the warp and weft of scenery, and the proper understanding of Turner's work as portrayer of scenery has been greatly hindered by the fact that such artists are described as landscape painters, and further by the circumstance that the salability of their work depends largely upon giving the picture a local name. Turner's pictures may be divided into two classes, those in which the *motif* is provided by the features of the landscape proper and those in which the *motif* is provided by the aspect of the weather; and the latter are probably the more important part of

Turner's contribution to nature study. Mr. Bonacina's detailed discussion of notable examples of Turner's pictures in the National Gallery, the Tate Gallery, and the Victoria and Albert Museum deserves the careful consideration of students of both science and art. The attention of these specialists and also of persons of general culture may properly be directed to the following sentence in which the outlook of the author is strikingly expressed: "the co-ordination and unification of truth acquired on the one hand through scientific research and on the other expressed through artistic intuition are the intellectual needs of the age".

Recent Work in Meteorology

The annual report of the Director of the Meteorological Office for the year ended March 31, 1938, describes the work of a period during which attention has been focused on the ever-growing needs of the rapidly expanding Royal Air Force and civil aviation. Many new meteorological stations were opened during that period on service and civil aerodromes as trained staff became available. The installation of direct teleprinter connexions between the meteorological stations in the country and the Air Ministry Meteorological Office headquarters was begun and arrangements for its extension to the constantly growing network of similar stations had to be considered. Meteorological information for the trans-Atlantic flights of July 1937 was supplied from stations set up at the Shannon Airport and at Botwood. The first of these was worked on an agency basis by the Meteorological Office for the Government of Eire, and the second was operated by the Canadian Meteorological Service on behalf of the Government of Newfoundland. Conferences were held afterwards at Toronto and Dublin to review the meteorological organization and improve it.

On the research side, important work was done in collaboration with the National Physical Laboratory in developing apparatus for measuring upper air conditions by radio instruments carried on unmanned balloons, so as to obtain immediate information about wind, pressure and temperature up to greater heights than could be reached when observations were made in aeroplanes. An additional advantage from the new methods is that the information can be obtained in weather dangerous for flying. Climatic conditions in Africa during years when there were serious outbreaks of locust swarms were under investigation on behalf of the Committee on Locust Control.

Electric Heating for Merchant Ships

The heating installation of a merchant ship is very different from that of a building on shore. An ocean-going merchant ship may sail into cold weather at any time of the year. In the course of a week she may sail from tropical heat into almost arctic conditions; and in a voyage of a month's duration she may sail from winter in one hemisphere, through spring, summer and autumn, or vice versa, and come into winter conditions in the other hemisphere. A paper on this subject was read to the Institution of Electrical Engineers on November 24 by H. C. Macewan. A difficulty of arriving at a simple method of calculation, like that used for computing the electric heating for a building, arises from the fact that the regulations quoted in specifications are very vague. Recently the British Board of Trade stated in its instructions to its surveyors in relation to master's and crew's spaces that "a heating system will be considered satisfactory if it is capable of maintaining a temperature of 60° F., when the temperature of the outside air is 30° F." This, although a useful help for making calculations, is insufficient as the basis for a test to show the adequacy of the heating. Mr. Macewan has collected data for the calculation of quantities and gives a general review of the problem as it exists to-day. He points out that the capital cost of the electric heating of ships is usually less than that of other systems as it is cheaper to run electric cables than pipes. In running cost also, electric heating is cheap, as it usually acts as a 'demand leveller' and it is seldom necessary to run an extra generator.

Broadcasting in India

In *Electrotechnics*, the journal of the Electrical Engineering Society of the Indian Institute of Science, Bangalore, of April, we learn that the Government of India is making progress with the construction of broadcasting stations. In December 1937, the 5-kw. medium-wave transmitter at Lahore and the 10-kw. short-wave station at Delhi commenced operation. The short-wave station at Bombay—also of 10 kw.—started to radiate early in February, and Lucknow early in April. The 0·25-kw. medium-wave and the 10-kw. short-wave transmitters at Madras were put into regular service from the middle of June. The Trichinopoly 5-kw. medium-wave station is expected to commence operation at an early date. Several Provincial Governments have already distributed a small number of receivers for group listening in villages. The broadcasting authorities of the Central Government have under way a programme for installing 120 receivers in as many villages in the Delhi Province. At the present moment, the broadcasting service touches but a fringe of the population and the programmes are of limited appeal. The element of novelty and wonder is still the dominating factor in reception amongst all classes of listeners. Listening for pure entertainment and enjoyment, oblivious to the mechanism, is as yet virtually non-existent in India. Until the present uncritical listening gives place to the habit of turning to radio for enjoyment, such questions as the acoustical requirements of studios and the special requirements demanded by Indian music and its technique can receive no adequate and satisfactory answer. In this journal, Mr. K. Sreenivasan's thoughtful address on the design of studios for broadcasting is published.

Oxford Science

The first number of a new shilling quarterly called *Oxford Science*, edited and published by the Junior Science Club, and printed at the Oxford University

Press, appeared this week. All new journals of this kind are necessarily precarious ventures, but there are good hopes that this one will fulfil the need it has been produced to meet. It is taking the place of the *Transactions* of the Club, which have been published now for more than fifty years. It will contain the more important lectures given from time to time to the Club, discuss problems connected with study and research in science and medicine at Oxford and review the work of the different scientific departments. The opening number contains the Robert Boyle lecture by Sir Edward Mellanby on methods of discovery in the fight against disease, an article by Prof. F. Paneth on atomic transmutation, an account of recent investigations on the structure of proteins by D. Parker Riley and an article discussing and criticizing medical curricula by one of the medical tutors. Some of the articles are illustrated. There are also editorial and other notes and a few book reviews. Altogether this is a lively first number that should make a wide appeal to the student of science interested in other sciences besides his own and in the problems that their impact on the world and the university has produced.

Gardeners of Essex

THE presidential address of Dr. John Ramsbottom to the Essex Field Club provided an opportunity to present much historical gardening knowledge in a pleasant, intimate form ("Old Essex Gardeners and their Gardens", *Essex Naturalist*, **26**, 65–103; 1938). *Yucca* first flowered in England during the year 1604, in the garden of William Coy at Stubbers, North Okington. This same garden also enjoys the distinction that it was the source whence the ivy-leaved toadflax, *Linaria cymbalaria*, first spread to become apparently native upon walls throughout England. It would be difficult to over-estimate the valuable work of another Essex gardener, Lord Petre, who stimulated the collection of many foreign plants which have become accepted beautifiers of British gardens. Richard Warner of Woodford introduced the genus *Gardenia* to English horticulture in 1754, and Dr. John Fothergill, 1712–80, had an influence similar to that of Lord Petre. He stimulated numerous useful projects, and himself cultivated many new and curious plants. No geographical limits were set by these Essex plant collectors, but they appear to have been especially responsible for the introduction of North American species to the gardens of Europe.

National Planning

THE Town Planning Institute has issued a report of the National Survey and National Planning Committee (price 1*s*.). The report stresses several matters of importance, and points out that in England and Wales (for Scotland is not included) about three quarters of the local authorities have applied the various Acts to about two thirds of the total land area. The process of planning, however, appears to be slow and essentially local in outlook. The Committee believes that national planning is required to supplement and reinforce local and regional planning. There is no national policy or guidance in the preservation of land for agriculture and for the reservation of national parks and other large open spaces. Further, in problems of transport, such as roadways and airports, a national, rather than a regional, outlook is necessary. The report contains a strong plea for a new department of Government which should take the form of a National Planning Commission. Its functions would be, first, the completion of a national survey, and secondly, advice and guidance to other Government departments and local authorities. Thus it would be possible to formulate and execute a national policy in the utilization of land.

Earthquake in the East Indies

THE U.S. Coast and Geodetic Survey, Washington, D.C., has announced the occurrence of an earthquake on October 10d. 20h. 48m. G.C.T. with provisional epicentre lat. 1° N., long. 125° E. The epicentre was determined from instrumental data obtained at twelve United States seismological observatories. The epicentre is to the west of the Molucca Passage and the nearest town of any size is Menada in the north of Celebes. No damage has so far been reported from here. According to Dr. S. W. Visser and his colleagues of the seismological observatory at Batavia, small earthquakes are quite frequent near this spot. World-shaking earthquakes are somewhat infrequent, however, and the last ones were the swarm of July 10–12, 1926, epicentre lat. 1° N., long. 126° E. It is possible that the earthquake on July 10, 1926, was multiple, as the *P* residuals appear to show groupings which are confirmed by the *S* residuals.

Traffic in Women and Children

THE League of Nations Committee for the Suppression of Traffic in Women and Children recently proved by investigation that there is a connexion between licensed houses of prostitution and traffic in women. The League, therefore, sought information from many Governments and voluntary associations respecting the early lives of women who afterwards became prostitutes, and has issued an analysis of this information, with comments, in a report recently issued ("Prostitutes: their Early Lives". Geneva, 1938. London: Allen and Unwin. 3*s*.). Some 60 per cent of the women were considered to be below normal in intelligence. Poverty and destitution, early seduction, and the desire for an easy life seem to be the main causes responsible for women adopting this kind of life.

Monkeys as Botanical Collectors

THE *Kew Bulletin* No. 7, 1938, quotes from the annual report of the Director of Gardens, Straits Settlements, an account given by the acting director, Mr. E. J. H. Corner, of the use made of berok monkeys (*Macacus nemestrina*) to collect specimens from tall trees. Two young beroks are at present employed; they understand twelve words of Kelantanese and can thus be instructed to pick specific twigs and drop them to the ground. Mr. Corner states, "A berok upon the shoulder can be likened, in effect, to a falcon on the wrist; and its employment is recommended both to amateurs for its charm and cheap-

ness and to keepers of Reserves where it is desirable to collect specimens repeatedly from the same trees without damage to them."

Science Masters' Association

The thirty-ninth annual meeting of the Science Masters' Association will be held in the University of Cambridge on January 3–6, 1939. On January 3, Prof. J. Gray will deliver his presidential address on "The Role of Science in Education". The following lectures have also been arranged: Prof. E. V. Appleton: "The Upper Atmosphere"; G. C. L. Bertram, "Animals of the Antarctic"; Prof. R. G. W. Norrish, "Experiments in Photochemistry"; Prof. W. L. Bragg, "X-Ray Optics"; Prof. O. T. Jones, "The Making of a Geological Map"; Dr. H. B. Cott, "Visual Concealment in Nature and in War"; N. E. Odell, "Everest, 1938". On January 6, a discussion will be held on "Films in the Science Classroom". Further information can be obtained from Mr. W. Ashhurst, The Grammar School, Stretford, Lancs.

The Night Sky in December

The night lasts for 16½ hours in the latitude of London at the time of the winter solstice on December 22. The moon is full on December 7 and new on December 21. The moon's altitude when southing at Greenwich on December $8^d\ 0^h\ 27^m$ U.T. is 58½°. No star brighter than mag. 5½ is occulted during the month. Conjunctions between the moon and planets occur as follows: December $3^d\ 2^h$, Saturn: $17^d\ 7^h$, Mars: $18^d\ 16^h$, Venus: $20^d\ 14^h$, Mercury: $27^d\ 0^h$, Jupiter: $30^d\ 11^h$, Saturn. On December 5 there is a fairly close approach between the moon and Uranus, actually resulting in an occultation of the latter as seen from parts of Asia and North America. Jupiter and Saturn are both evening stars. At about $18\frac{1}{4}^h$ on the following dates, the four inner satellites are grouped fairly closely to Jupiter, being easily seen in a pair of binoculars: December 1^d (Satellite I occulted), 2^d, 10^d (Satellite IV occulted), 17^d, 18^d, 19^d, 25^d to 28^d. Mercury, Venus and Mars are all morning stars. In mid-December, Venus rises about 5^h; it is at its greatest brilliancy (mag. −4·4) on December 26. The variable star, Algol, is well placed for observation during the month. The approximate times of primary minima accessible to observation are on December $2^d\ 4{\cdot}5^h$, $5^d\ 1{\cdot}3^h$, $7^d\ 22{\cdot}1^h$, $10^d\ 19{\cdot}0^h$, $25^d\ 3{\cdot}1^h$, $27^d\ 23{\cdot}9^h$, $30^d\ 20{\cdot}7^h$. On or about December 11 the Geminid meteors are at their maximum. In the middle of the month at midnight, there is a fine array of bright stars on the southern meridian.

Announcements

Prof. Andrew Cowper Lawson, emeritus professor of geology and mineralogy at the University of California, has been awarded the Penrose Medal, highest honour of the Geological Society of America, "for eminent research in pure geology, and outstanding original contributions and achievements which mark a decided advance in the science of geology".

Prof. James Kendall, professor of chemistry in the University of Edinburgh, will deliver the Christmas Lectures "adapted to a juvenile auditory" at the Royal Institution on January 3, 5, 7 and 10. The subject of the lectures will be "Young Chemists and Great Discoveries".

Mr. K. de B. Codrington, keeper of the Indian Section of the Victoria and Albert Museum, has been appointed to give the Charles Phelps Taft Memorial Lecture at the University of Cincinnati in January. Mr. Codrington has been attached to University College, London, for many years as honorary lecturer in Indian art, and is chairman of the Indian Research Committee of the Royal Anthropological Institute. He held the chair of archæology at the University of Cincinnati in 1925–26. His present invitation to the United States is an indication of the increasing interest there in India, and especially Indian art. Mr. Codrington intends to investigate the educational activities of various museums in the United States during his visit.

The Nobel Peace Prize for 1938 has been awarded to the Nansen Office for Refugees in Geneva. The Nansen Office ceases its activity at the end of this year, and its duties will be continued in London by the newly founded International Commission for Refugees. The Prize will automatically be transferred to the new Commission in London, the director of which is Sir Herbert Emerson.

The Geophysical Discussion at the Royal Astronomical Society on "The Night Sky and Aurora", arranged for January 27, has been postponed to May 19. The discussion arranged for May 26 is cancelled. On March 24, 1939, Dr. E. C. Bullard will open a discussion on "Recent Geophysical Investigations at Sea".

Messrs. Francis Edwards, Ltd., 33 Marylebone High Street, W.1, have issued a catalogue (No. 630, 1938) containing many rare examples of books relating to the sea, atlases, autograph letters, log books, etc. The gems of the collection are, perhaps, a fine first edition of Sir William Alexander's "An Encouragement to Colonies" (1624), "Hakluytus Posthumus" of Purchas (1624–26), "The Principal Navigations" of Richard Hakluyt (1598–1600) and an atlas, the "Strassburg Ptolemy" (1513). There is also a long series of works, with many rarities, dealing with the *Bounty* mutiny and Captain Cook's voyages. Among scientific works listed we notice copies of the "Challenger Report", Sir J. D. Hooker's "Botany of the Antarctic Voyage" of the *Erebus and Terror*, the "Botany and Zoology of the Voyage of H.M.S. 'Sulphur' ", Darwin's "Surveying Voyages of H.M.S.'s 'Adventure' and 'Beagle' ", and a complete set of the *Journal of the Polynesian Society*.

In the short notice of J. Halcro-Johnson's "Reverse Notation" on p. 775 of Nature of October 29, the reviewer, in quoting examples of the abundance of negative digits, inadvertently omitted the word 'minus' before log $6{\cdot}\bar{3}\bar{3}5$. According to the reverse notation, log $6{\cdot}\bar{3}\bar{3}5 = 1{\cdot}\bar{3}\bar{2}04$, but in converting subtraction into addition, minus log $6{\cdot}\bar{3}\bar{3}5 = \bar{1}{\cdot}3204$ is used.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 959.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Distribution of the Bridled Form of the Common Guillemot (*Uria aalge*)

THIS subject forms an excellent illustration of how character gradients in and between geographical races of animals submit to the treatment suggested by Huxley[1]. In this instance, the cline—to make use of his term—is one in the proportions of polymorphs. The bridled form of *Uria aalge*, a mutant, which apparently depends on a single gene difference and is distinguished by a white circle around the eye continuing backwards as a line towards the region of the nape, represents a larger percentage of the guillemot population in the north of its range than in the south. It is clear that more details of this cline will reveal important facts, such as the groups that are situated on it and the relationships between them. During the past breeding season, the British Trust for Ornithology has organized a co-operative inquiry into the status of the bridled guillemot in the British Isles, and, although it is hoped to continue this inquiry during the coming season to fill in the remaining gaps, enough is now known to encourage a preliminary publication.

Observers were asked to visit as many breeding colonies as possible, to count at least two hundred birds from representative parts of the colony and to note the number of bridled birds in their total. Fairly complete figures have been obtained except for colonies down the west coast of Scotland and Ireland, for which information is still badly needed. Where two observers sent in counts for one colony, percentages were first worked out for each to find out what was the discrepancy. Since this was in every such case insignificant, the counts were added together.

The results for the British Isles are shown on the accompanying map, where the figures shown in circles denote the percentage of bridled birds in that particular colony.

The following points illustrating the nature of the cline may be noted:

(1) At all the English and Welsh colonies the percentage is very small.

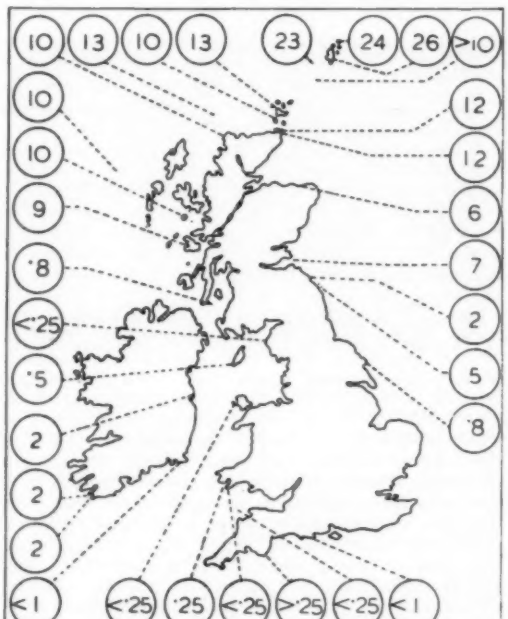
(2) At about lat. 56° N. the numbers commence to rise. Along the east coast of Scotland there is a fairly steep and regular cline, while on the west coast there is marked discontinuity, though this may be due to incompleteness of figures.

(3) Between Fair Isle and Shetland there is again marked discontinuity, the proportions rising from 10–13 per cent, which is characteristic of the whole north Scottish area, to 24 per cent.

(4) In Ireland there may possibly be a gradually rising cline in a north-westerly direction, but more figures are needed to confirm this.

(5) In the region of rapid change off the Northumberland and Berwick coasts there is even a reversal of the cline at St. Abb's Head and the Farnes, showing that differences are more likely to establish themselves in such regions.

As regards the rest of the guillemot's breeding range, the cline is continued northwards and southwards of the British Isles. France has very occasional bridled birds, Heligoland 1 per cent, Götland 1 per cent, Faeroes 34 per cent, Iceland more than 70 per cent, Magerö, North Cape, more than 50 per cent, Bear Island more than 50 per cent and Novaya Zemlya (where only very few *Uria aalge* breed, most being *Uria lomvia*) less than 40 per cent.



PERCENTAGES OF BRIDLED GUILLEMOTS AT COLONIES IN THE BRITISH ISLES.

In North America, the situation in the east coast colonies has recently been studied by Johnson[2], who reports 15·7 per cent of the breeding population to be bridled. Whether any similar cline from south to north is found there does not seem to be known.

Another cline is also found in *Uria aalge*. Birds from the southern part of the range are brownish on the back, while those from farther north show a considerably deeper colour, which is almost black. Subspecies have been named from back colour and

other characters. It may be significant that the change from *Uria aalge albionis* to *Uria a. aalge* corresponds with the first zone of change in percentage of bridling, but it does not seem safe to postulate a causal connexion between the cline in polymorph frequencies and that in melanin pigmentation on the present evidence.

The genetic situation involved is of some interest. From the non-existence of intermediate forms it may be assumed that the control is unifactorial. Whether it behaves as dominant or recessive is, however, less clear, and only breeding experiments or ringing of wild populations could decide this.

This method of describing sub-species and forms makes a useful addition to the usual taxonomic procedure and gives important information as to the processes of species differentiation, the methods by which isolation arises in a widespread group and the speed with which genes may diffuse across such barriers.

H. N. Southern.

Bureau of Animal Population,
University of Oxford.
Oct. 27.

[1] Huxley, J. S., Nature, **142**, 219 (1938).
[2] Johnson, R. A., *Auk*, **35**, 56–61 (1938).

Tellurium Tetrafluoride

The formation of a white solid which accompanies the main product tellurium hexafluoride when fluorine is passed over tellurium has often been noticed but its composition has not been settled (Moissan[1], Prideaux[2]). Yost and Claussen[3] showed that the same or a similar substance is formed by heating the hexafluoride with tellurium in sealed glass tubes, but they were unable to identify the product, which they state is probably the difluoride, TeF_2.

We have re-investigated the reaction using sealed tubes of both glass and silica. With the hexafluoride alone in the tubes, no reaction occurs and the density of the gas remains unchanged. With tellurium present, a white solid is formed at a temperature of about 200° C. The ratio of fluorine to tellurium in this solid is not constant but decreases with the time the tube is heated, until after heating for several days, the fluorine content becomes very small and the solid approximates in composition to TeO_2. At the same time the gas pressure in the tube rises and finally attains a value 1·5 times the initial pressure. The gas, originally pure TeF_6, is converted completely into SiF_4, as shown by vapour density measurements. The most probable explanation of these facts seems to be that the first product of the reaction is the formation of a new compound, tellurium tetrafluoride, which then reacts with the silica giving silicon fluoride and tellurous oxide:

$$(1)\quad 2TeF_6 + Te = 3TeF_4.$$
$$(2)\quad 3TeF_4 + 3SiO_2 = 3TeO_2 + 3SiF_4.$$

Further investigation has confirmed the correctness of this interpretation. We have found that the product of the first reaction can be isolated by using a tube composed of pure crystalline alumina. This material, as supplied by the Thermal Syndicate, Ltd., is non-porous and is the only one we have found which is not attacked by this reaction.

In these conditions, the tellurium hexafluoride is absorbed completely by the tellurium at about 200° C., forming a colourless solid which crystallizes in fine needles on the walls of the tube. On exposure to ordinary air, the solid hydrolyses very rapidly with evolution of hydrogen fluoride. By dissolving this product rapidly in aqueous potash, we have been able to determine the ratio F : Te in the substance. Two independent experiments showed it to approximate closely to 4 : 1.

Quite recently we have been able to prepare larger amounts of the white crystalline material free from excess of tellurium, and to analyse it completely. As a mean of two experiments, we find for its composition: Te = 62·5 per cent, F = 38·7 per cent. The formula TeF_4 contains Te = 62·6 per cent, F = 37·4 per cent. The fluorine was estimated as lead chlorofluoride after precipitation of tellurium as dioxide—a method which we have found to give rather high results when used for the estimation of this element in compounds of tellurium and fluorine.

The results can therefore be regarded as satisfactory, and there can be little doubt that the white solid we have obtained is a new fluoride of tellurium, TeF_4, which on account of its reactive behaviour with glass and silica and its instability in presence of traces of moisture has not been isolated previously.

Further experiments on the properties and behaviour of this substance are in progress.

G. A. R. Hartley.
T. H. Henry.
R. Whytlaw-Gray.

Chemistry Department,
University,
Leeds.
Nov. 1.

[1] Moissan, *Ann. Chim. Phys.*, **24** (6), 239 (1891).
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Fate of the Sulphate Radical in the Animal Body

Phosphorus enters as phosphate in the numerous compounds in which it is to be found in the animal body; in connexion with the investigations carried out in recent years concerning the fate of ingested phosphorus atoms in the organism, it seemed to be of interest to determine whether or not, in the course of the numerous metabolic processes in which phosphorus is involved, the phosphate radical exchanges its *oxygen* content with other oxygen atoms present in the body. This question could be answered by injecting into an animal sodium phosphate which contained heavy oxygen (^{18}O) as an indicator and then determining if the phosphate recovered in the urine, for example, contained more than the normal amount of ^{18}O.

As, however, it was recently found[1] that 'heavy-oxygen phosphate' can be obtained by dissolving sodium phosphate in 'heavy-oxygen water' and vice versa, it is apparent that the oxygen atoms present in phosphate radicals exchange their places freely in water and there can be scarcely any doubt that the probability is extremely small of a phosphate radical leaving the body coupled to the same oxygen atoms with which it entered. Sulphate ions, on the other hand, have been found[2] to exchange oxygen atoms either not at all or at a very slow rate with neutral water, even at 100° C., and it seemed of interest, therefore, to investigate whether sulphate ions during their circulation in the body participate in chemical reactions which loosen the oxygen bonds sufficiently to make an oxygen exchange possible.

In the experiments we wish to report here, sodium sulphate containing heavy oxygen was prepared from heavy-oxygen water, kindly presented to us by Prof. Urey[2], having a density 740 parts in a million greater than that of normal water. The reaction used for the preparation of the 'heavy sulphate' was that which takes place between SO_2Cl_2 and heavy-oxygen water in the presence of traces of iodine as a catalyst. 1 gm. of the dry material, converted into 50 c.c. of solution, was injected into a rabbit; we are very grateful to Miss Lindberg, of Prof. Krogh's laboratory, for making the injections. The urine of the rabbit was then collected for 24 hours, its sulphate content recovered as barium sulphate, the oxygen content of the latter converted into water, and the density of this determined. The preparation of water from the oxygen of the sulphate was carried out in the following way. The barium sulphate precipitate was dried at 400° C. in a stream of nitrogen and then reduced with purified carbon at 900° C.; the gases evolved were mixed with a great excess of hydrogen and stored over oil in a gasometer; and, finally, the gas mixture was led over a nickel catalyst at 310° C. and the water formed collected. The density determination was kindly carried out by Mr. O. Jacobsen, using Linderstrøm-Lang's floating-drop method.

Should the sulphate oxygen, during its stay in the animal, enter into exchange reactions with other oxygen atoms present in very great excess in the body, the oxygen of the heavy radicals would be replaced by normal oxygen atoms and the water prepared from the sulphate recovered from the urine would show the density of normal water. If, on the other hand, the sulphate ions injected retain the oxygen atoms with which they start, the water prepared from the urine sulphate should show an excess density of 370 parts per million if no secretion of normal sulphate took place. The water prepared from the sulphate isolated from the urine after injecting heavy-oxygen sulphate has shown a very appreciable density excess—240 parts per million. When comparing this value with the one calculated on the assumption that no exchange of sulphate oxygen took place, we must consider the following fact. Besides the heavy-oxygen sulphate—0·84 gm. of sodium sulphate being secreted in all during the day following injection—the urine contains also sulphate, even when no injection is given, the amount of which we found to correspond to 0·23 gm. per day. The latter is normal sulphate and its presence reduces the density excess of the water prepared from the urine sulphate.

From the high density found for the water prepared from urine sulphate, one must conclude that most of the individual sulphate ions injected into the rabbit are recovered in their original form, and from this it follows that at least the greatest part of the sulphate administered leaves the body unchanged, and also that none or only a small part of the ingested ions exchange as such with other sulphate ions present beforehand in the tissues.

A. H. W. Aten, jun.
G. Hevesy.

Institute of Theoretical Physics,
Copenhagen.

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[2] Datta, S. C., Day, J. N. E., and Ingold, C. K., *J. Chem. Soc.*, 1968 (1937).
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Distribution of Phosphorus in the Leg Bones of Chickens

In rickets, as is generally known, the total phosphorus content of the bones is diminished. We have started now to investigate the distribution of phosphorus in the leg bones of normal and rachitic chickens with a radioactive phosphorus isotope as an indicator.

The active phosphorus used was prepared by Dr. F. A. Heyn, of the Philips Lamp Works at Eindhoven, with a Philips neutron generator[1]. A fixed quantity of the active phosphorus was injected intraperitoneally as an aqueous solution of sodium phosphate of *p*H 7·2. The chickens were decapitated 22 hours after the injection and quickly sectioned. The leg bones were then dissected and cleaned. One of the leg bones of each bird then was divided into three parts, namely, the proximal epiphysis, the distal epiphysis and the diaphysis. The two epiphysial parts of the bone were then carbonized together in an oven at 200° C.; the same was done with the diaphysis. Preparations for the determination of the radioactivity were made in the manner described previously[2]. In addition, a part of the residue of carbonization was used for the estimation of the total phosphorus according to Fiske-Subbarow.

As was to be expected, the provisional figures from eight chickens showed that the phosphorus content of the dried matter in the epiphysial part and in the diaphysial part is larger in normal than in rachitic chickens. Furthermore, it was observed that both in normal and in rachitic chickens, the phosphorus content from the diaphysial part of the bone seems to be larger than that from the epiphysial part of the same bone.

With regard to the distribution of the active phosphorus administered, it was observed that, both in the normal and in the rachitic chickens decapitated 22 hours after the injection of the labelled phosphorus, the quantity of the active phosphorus in 1 mgm. of bone phosphorus was larger in the epiphysis than in the diaphysis. Furthermore, it was observed that both the epiphysis and the diaphysis from the rachitic birds, decapitated 22 hours after the injection of the labelled phosphorus, contained a much larger quantity of the active phosphorus in 1 mgm. bone phosphorus than the normal chickens.

The second leg bone of each chicken was not carbonized, but after being cleaned was placed on a double coated X-ray film. It remained on this film for some days, according to the quantity of radioactive phosphorus injected. The film was then

developed; a clear picture of the whole bone was visible, as is shown by the accompanying photographs. It is convincingly shown in these that the epiphysis contains a larger quantity of the active phosphorus than the diaphysis does. Hence the results of measurements of the radioactivity of the several parts of the bone are fully in accordance with the photographs obtained.

Thus it appears from the radioactivity measurements and also from the radiographs that phosphorus metabolism is more intense in the bone of the rachitic chicken than in the bone of the normal chicken, and also phosphorus metabolism is more intense in the epiphysial part than in the diaphysial part of the same bone.

We are now trying to investigate whether it is possible to estimate photographically the quantity of the active phosphorus present in the several parts of a bone.

Finally, we wish to express our thanks to the Philips Lamp Works for furnishing the radioactive phosphorus used in these experiments, and to Mr. J. C. de Back for his assistance in these investigations.

M. J. L. Dols.
B. C. P. Jansen.
Laboratory of Physiological Chemistry,
University, Amsterdam.
G. J. Sizoo.
G. J. van der Maas.
Natuurkundig Laboratorium,
Vrije Universiteit,
Amsterdam.
Oct. 27.

[1] Brouwers, A., Heyn, F. A., and Kuntke, A., *Physica*, **4**, 153 (1937).
[2] Nature, **139**, 1068 (1937); *Proc. Roy. Acad., Amsterdam*, **40**, 547 (1937).

Enzymic Deamination of Aspartic Acid

From the cell-free solution of *B. fluorescens liquefaciens*, which has a powerful aspartase effect[1], we have isolated aspartase by adding acetic acid up to *p*H 4·6 at 0° C. The precipitate thereby formed (precipitation begins at *p*H 4·8) gives, when rapidly filtered and dissolved in *M*/15 phosphate buffer (*p*H 7), a solution which possesses considerable aspartase and also asparaginase effect. This solution has no fumarase effect, even in experiments of long duration.

Despite the absence of fumarase, the enzyme solution obtained forms malic acid from fumaric acid in the presence of ammonia. The reaction occurs also in the presence of toluene. When a longer time is allowed, the reaction goes so far that only aspartic acid, malic acid and ammonia can be found in the solution; fumaric acid is not detectable. If we start with *l*-aspartic acid, there are formed fumaric acid, malic acid and ammonia. Fumaric acid is not converted into malic acid by our enzyme solution, if ammonia is absent.

The results led to the conclusion that the purified fumarase-free enzyme solution contains two different enzymes. One (I) is the actual aspartase and catalyses the reaction:

$$HO_2C.CH_2.CH(NH_2).CO_2H \rightleftharpoons HO_2C.CH=CH.CO_2H + NH_3;$$

the other (II) catalyses the following reaction:

$$HO_2C.CH_2.CH(NH_2).CO_2H + H_2O \rightarrow HO_2C.CH_2.CH(OH).CO_2H + NH_3.$$

Thus the hydrolytic deamination of an amino acid would be established for the first time. The latter reaction is not reversible. The conversion of fumaric acid into malic acid in the presence of ammonia proceeds through aspartic acid. Consequently, enzymes I and II are required for the reaction. Enzyme II acts more slowly than Enzyme I; therefore at first chiefly fumaric acid and ammonia are formed from aspartic acid.

We report the above results because Gale[2] has recently published investigations on the separation from the raw aspartase in *B. coli*-juice two different enzymes deaminating *l*-aspartic acid. One of his enzymes, however, does not act in the presence of toluene, and both of them contain fumarase, thus preventing elucidation of the mechanism.

In addition, we have also noted that the aspartase effect of the enzyme solution is approximately proportional to the enzyme concentration. Systematic exceptions to this rule are noted in that small quantities of enzyme act more favourably during a long reaction time than do large quantities during a short reaction time. The equilibrium constant for deamination obtained with a fumarase-free preparation was $K_{37} = 100$.

With the enzyme solution or with the suspension of *B. fluorescens liquefaciens* we were unable to accomplish the amino acid synthesis from oxalacetic acid and ammonia, or from succinic acid and ammonia.

A detailed account of this work will be published elsewhere.

Artturi I. Virtanen.
Jorma Erkama.
Biochemical Institute,
Helsinki.
Oct. 24.

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[2] Gale, *Biochem J.*, **32**, 1583 (1938).

Oxygen Exchange during Esterification

In a recent paper[1] on the exchange of oxygen between water and acetic acid, we pointed out that the mechanism of the exchange of the carboxyl oxygen atoms of the acid with the oxygen of the water, H–OH, was probably identical with the mechanism of esterification of an acid by an alcohol, *R*–OH, and ventured to predict that "when esterification of an acid occurs in the presence of about equal quantities of alcohol and water an exchange will be observed between the oxygen of the water and that of the acid running parallel to the simultaneous rate of esterification". We mentioned that we were carrying out experiments to test this view.

Meanwhile, Urey and Roberts[2] have esterified benzoic acid with methanol containing excess of the heavy oxygen isotope in order to determine which linkages are broken during esterification. They found it necessary to apply to their results a correction for the exchange between benzoic acid and the water formed during the esterification. They therefore measured also the rate of exchange between benzoic acid and heavy oxygen water under the same conditions as those pertaining during esterification.

Urey and Roberts find that 0·1505 moles of the acid were esterified, while simultaneously 0·0726 moles of the acid exchanged *both* its oxygen with those of the water. Taking into account the relative concentration (or better, the activities) of the water and methanol in the reaction mixture, this result indicates

that the velocity constant of the exchange reaction is about five times as great as that of the esterification. This difference corresponds to a difference of only 1,000 calories in the activation energies, and we therefore consider that the above result supports our prediction.

J. B. M. Herbert.
I. Lauder.

Chemistry Department,
University,
Manchester.

[1] *Trans. Far. Soc.*, **34**, 1219 (1938).
[2] *J. Amer. Chem. Soc.*, **60**, 2393 (1938).

Crystal Analysis and Point Sets

It is customary in X-ray crystallography to regard a crystal as a continuous distribution of scattering matter, expressible in the form of the electron density function:

$$\rho(x, y, z) = \frac{1}{v} \Sigma\Sigma\Sigma F(h, k, l) \exp [- 2\pi i(hx/a + ky/b + lz/c)] \quad (1)$$

$$= \frac{1}{v} \Sigma\Sigma\Sigma r(h, k, l) \exp [i\alpha(h, k, l) - 2\pi i(hx/a + ky/b + lz/c)]$$

Whereas X-ray techniques permit the determination of the amplitudes r, they do not determine the phases α. This, as is well recognized, has been the essential limitation in X-ray analysis, not as a method of testing structures already proposed, but as a method of discovering the atomic structure of crystals. This difficulty prompted the introduction of the derived function[1]:

$$A(x, y, z) = \frac{1}{v} \int_0^a \int_0^b \int_0^c \rho(X, Y, Z)\, \rho(X + x, Y + y, Z + z)\, dx dy dz$$

$$= \frac{1}{v} \Sigma\Sigma\Sigma R(h, k, l) \exp 2\pi i (hx/a + ky/b + lz/c), \quad (2)$$

where

$$R(h, k, l) = |F(h, k, l)|^2 = (r(h, k, l))^2, \quad (3)$$

which is thus expressible in terms of the observed amplitudes and is independent of the unobserved phases. This function (representing the weighted distribution of density in the crystal about any point) can be used in conjunction with any structure already proposed, to pass it for further consideration or to reject it, according as its vector function does or does not tally with it.

While in particular cases it must be agreed that passing a test of so high an order of delicacy is sufficient to establish a proposed structure to all intents and purposes, the mathematical interest of the use of vector functions lies in the question as to the complete inventory of structures which satisfies a given vector map (which may be none) a question to which the method of expressing an electron density distribution in the form (1) supplies no answer. For all that can be said is that all electron density functions of the form (1) share the same vector function, namely, the vector function (2), when and only when condition (3) is satisfied—and this brings us back again to the difficulty of the unobservable phases which, it would seem, the introduction of vector functions does nothing to dispel.

To meet this difficulty, an alternative approach to the problem, originally introduced in a study of the structure of insulin[2], has been exhaustively developed[3]. It bears to the customary approach the same relation as the quantum theory of light bears to the classical theory, picturing a crystal as a point intensity distribution in atomic space S_1, corresponding to which there is a second easily derivable point intensity distribution in vector space S_2, which may be compared with the experimentally obtained vector maps already discussed. As an example of an S_2 distribution to which more than one S_1 corresponds, we may cite the periodic one dimensional arrays . . . 3, 7, -2, -5, 3, 7, -2, -5, . . . and . . . 7, 1, -6, 1, 7, 1, -6, 1, . . . which share the same vector map. It is possible systematically, in cases of gradually increasing complexity, to investigate all the S_1 distributions corresponding to a given S_2. Evidently the less symmetric the S_2 distribution, the smaller the multiplicity of its corresponding S_1 distributions. This new method entirely alters the situation regarding the possibility of using vector maps to discover the atomic structure of crystals. To illustrate the appropriate procedure, we discuss the projection on (0001) of the vector map of an insulin crystal[4]. It is hexadic and has only four sets of marked maxima O, A, B, C shown in Fig. 1, the intensities of which are in the order $O > B > A > C$ It has been found that this S_2 point distribution corresponds to two and only two S_1 point distributions shown in Figs. 1 *a* and 1 *b*. But the fact that the intensities of the S_2 points are in the order $B > A > C$ excludes the second of the two S_1 point distributions.

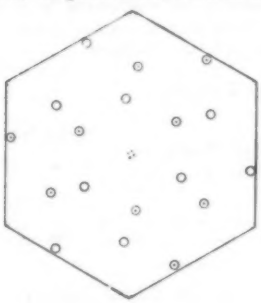


Fig. 1 *a*

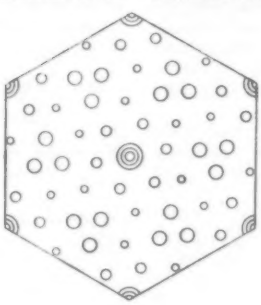


Fig. 1

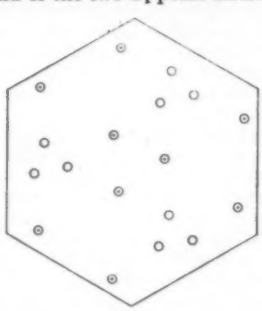


Fig. 1 *b*

Hence we deduce that, whatever the degree of approximation to which the point distribution in Fig. 1 represents the vector diagram of insulin, to that same degree of approximation the corresponding atomic distribution in crystalline insulin is represented by Fig. 1 *a* (broken circle = *c* appears at the centre and at each corner of the hexagon).

This procedure is further explained and developed in general in more detailed studies in course of publication. It is also being used to derive from the vector diagrams of insulin further and more detailed information regarding the atomic structure of crystalline insulin in investigations which may be regarded as supplementary to those already published[3,5], which have shown the delicate concordance between these diagrams and the vector map of the cage structure predicted for insulin[6] as a deduction from the cyclol hypothesis[7].

I am indebted to Prof. E. H. Neville for advice in connexion with this work.

D. M. Wrinch.

Mathematical Institute,
Oxford.
Nov. 10.

[1] Patterson, *Z. Krist.*, **90**, 517 (1935).
[2] Wrinch, *J. Amer. Chem. Soc.*, **60**, 2005 (1938).
[3] Langmuir and Wrinch, NATURE, **142**, 581 (1938) and forthcoming publications; Wrinch, *Phil. Mag.* (in the Press).
[4] Crowfoot, *Proc. Roy. Soc.*, A, **164**, 580 (1938).
[5] Wrinch and Langmuir, *J. Amer. Chem. Soc.*, **60**, 2247 (1938).
[6] Wrinch, *Science*, **85**, 566 (1937); *Trans. Faraday Soc.*, **33**, 1368 (1937).
[7] Wrinch, NATURE, **137**, 411 (1936) *et seq.*

Ionization of Air in an Air-conditioned Building

According to modern medicine, the electric condition of atmosphere is an important sanitary factor. In closed localities ventilated normally, man lives in a medium which has not the electric field of open air, but the average ionization of its air is, as a rule, the same as in the open air. There is normally also a slight excess of positive ions over negative ions, as out of doors. Cellars, where the air stagnates and where there is accumulation of radon (radium emanation) released from the walls, are an exception.

It was, therefore, interesting to ascertain the order of ionization of air inside buildings provided with Carrier air-conditioning equipment.

This equipment consists, in principle, of filters (viscous layers, glass or steel wool, etc.) or electric precipitators and air washers freeing the air from dust, and adjusting its humidity and temperature. It might be expected that the air is simultaneously freed also from its ions, which may be regenerated in the cleaned air only by the influence of radioactive radiation of the walls and other articles placed in the building, or by cosmic rays.

We had the opportunity of measuring ionization of air in the central office building of the municipal electricity works of the city of Prague. The central air-conditioning equipment, described by one of us[1], consists of the main filters, having a total surface of 48 sq. metres, after which the air passes through a chamber where it is washed with water. After being heated suitably, to adjust the humidity and temperature, the conditioned air is led through the main duct to the individual stories. It passes there through the local machines, where it is mixed with the return air cleaned by local filters. From the machine rooms, the air is guided in metal air ducts and inlets with grids, into the working rooms. The ducts are provided with silencers made of 'Celotex' and 'Tritex' to reduce sound. The amount of air drawn in per hour from the open atmosphere is 60,000 cub. metres minimum, 200,000 cub. metres maximum.

The content of small ions was measured by a compensating ion counter of special design[2] giving directly the number of small ions in 1 c.c.

The results are given in the accompanying table, where $n+$ and $n-$ are the number of small ions in 1 c.c. of air, q is polarity of spatial charge. The average temperature of the conditioned air was 19° C., relative humidity 62 per cent, except measurement No. 2, when the temperature of air was 12·3° C. and relative humidity 89 per cent.

Place	$n+$	$n-$	$q=\frac{n+}{n-}$
1. Outside air (open atmosphere)	300	260	1·15
2. Pit immediately behind the air washer	530	10,600	0·05
3. In the main duct for conditioned air, 1st floor	640	5,300	0·121
4. Ditto, 4th floor	550	4,650	0·118
5. Air inlet into the working room	200	1,900	0·105
6. Close to the wall of the working room 70 cm. above the floor	760	330	2·30
7. In the middle of the working room	775	895	0·866

Measurement No. 2 shows that the air is not freed from ions even after it passes through filters and is washed with water. There is an enormous excess of negative ions, forty times more than in the open air, which is evidently the Lenard effect, that is, separation of negative charges on breaking up water drops. A considerable excess of negative ions over the positive ones is maintained in the main duct for conditioned air up to the 4th floor, at an average speed of air of 195 metres per minute. The radioactive radiation of material of the walls and articles renews quickly (in about 10–15 minutes) the balance between the positive and negative ions. The walls tend to eliminate the negative ions, the mobility of which is greater than that of the positive ions, so that they are more absorbed on objects (see measurement No. 6). The average ionization ascertained in the working rooms, in the corridors and in the hall was twice as high as in the open air, the air showing as a rule a slight excess of negative ions over positive ions, that is, inverted polarity as against the normal polarity of open air. Permanently increased ionization of air in an air-conditioned building may have a certain physiological influence. It resembles a mountain climate, which is characterized always by a greater ionization than that of the lowlands.

F. Běhounek.

State Radiological Institute,
Prague.

J. Kletschka.

Municipal Electricity Works of
the City of Prague.
Oct. 25.

[1] Kletschka, J., *Gesundheits-Ingenieur*, No. 10 (1936).
[2] Běhounek, F., *La Presse thermale et climatique*, **79**, 350 (1938).

Velocity of Sound in Liquid Helium

Burton and others[1] have measured the velocity of ultra-sonic waves in liquid helium under its own vapour pressure, and compared the results with the thermodynamic properties of the substance. In the helium I range they derive an adiabatic compressibility, which shows a minimum at 2·5° K. In order to find the

isothermal values, we have to multiply by $\gamma = c_p/c_v$. γ can be calculated from the specific heat[2] at vapour pressure c_s with the help of the thermodynamic

T°K.	γ
2·25	1·02
2·50	1·10
3·00	1·3
3·50	1·6

diagrams[3]. It is interesting that in the isothermal curve the minimum has disappeared. The minimum in the adiabatic compressibility is connected with the rapid rise of c_p/c_v above the λ-point.

H. J. GROENEWOLD.

Kamerlingh Onnes Laboratory,
Leyden.

[1] Burton, E. F., NATURE, 141, 970 (1938); Findlay, J. C., Pitt, A., Smith, H. Grayson, and Wilhelm, J. O., *Phys. Rev.*, 54, 506 (1938).
[2] Keesom, W. H., and Keesom, Miss A. P., *Commun. Kamerlingh Onnes Lab., Leiden*, No. 235d; *Physica*, 2, 557 (1935).
[3] Keesom, W. H., and Keesom, Miss A. P., *Commun. Kamerlingh Onnes Lab., Leiden*, Suppl. No. 76b; *Physica*, 1, 128 (1933–34).

Vowel Vibrations and Vowel Production

PROF. E. W. SCRIPTURE, in a letter published in NATURE of October 1, suggests that the profiles of the various vowel sounds—of which he gives examples—indicate that these sounds "cannot have been produced by resonance".

I showed, in 1923 and 1924[1], that all the English vowels and consonants could be recognizably produced by the use of coupled resonators (of the Helmholtz type) suitably tuned to produce the principal resonant components that had been recognized by ear when listening to the speech sounds themselves—when those sounds were breathed or whispered. If the resonators were energized, by blowing (turbulent) air through or into them, they reproduced 'unvoiced' speech sounds. If they were energized by pulsating air—produced by first passing the energizing air current through a vibrating reed (equivalent to the vibrating action of the vocal cords)—the resonators reproduced voiced speech sounds. Incidentally, it was shown that vowel sounds could also be produced by coupling the resonators in parallel instead of in series.

That the resonant components were not imaginary was afterwards shown by I. B. Crandall and C. F. Sacia, of the Bell Telephone Laboratories[2], who proved their existence (together with other subsidiary resonances, not detected by ear) by purely instrumental means. Later, John Q. Stewart[3], in the Research Laboratory of the Western Electric Company of New York, and Dr. W. H. Eccles[4] showed that similar, recognizable, voiced vowel sounds could be produced by substituting electrical tuned circuits for Helmholtz resonators, and intermittent electrical impulses, in the place of intermittent air pulses for energizing the resonators. The resulting complex current, amplified and passed into a loud speaker, produced the voiced vowel sounds. In all these experiments, vowel- (or in some cases also consonant-) sounds were produced by the action of resonators.

It must be admitted that, in the case of human speech, the resonant conditions are more complex than in the experiment cited. The human pharynx, in particular, constantly varies in form during speech; the vocal cords also—as Prof. G. Oscar Russell has shown at Ohio University[5]—appear to modify their attitude, so as to assist the resonant effects. They probably supply a reed note which is rich in resonant components of about the right frequency to energize the principal oral resonance of each vowel sound.

There is the further difference that whereas the impulses produced experimentally by the artificial reeds (or equivalent) were relatively constant in frequency, those produced by the vocal cords are highly variable. But the evidence of the models appears to be conclusive that the human vowel sound is essentially an effect of resonance.

My own time is now fully occupied with the investigation of other aspects of human speech; but if any physicist (preferably in London) would care to make 'profiles' of the artificial vowel sounds produced by some of my resonators—to compare with those of human speech—I would gladly lend them for the purpose of the experiment.

R. A. S. PAGET.

1 Devonshire Terrace,
Lancaster Gate, W.2.
Oct 17.

[1] *Proc. Roy. Soc.*, A, 102 (1923); A, 106 (1924).
[2] "A Dynamical Study of the Vowel Sounds", *Bell System Tech. J.*, 3, No. 2, 232–237; and "Human Speech", 88–89.
[3] NATURE, 110, 311 (July 8, 1922).
[4] Royal Institution, 1923; and Phys. Soc. Jubilee Meeting, 1924. "Human Speech", 208.

Effect of Ultra-centrifuging the Oocytes of the Mouse

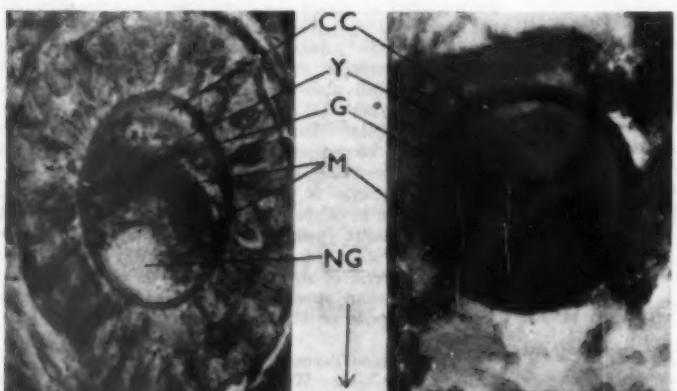
OVARIES of the mouse were centrifuged in the Beams ultra-centrifuge. In the young oocytes the cytoplasmic inclusions and components are stratified into three layers. The mitochondria occupy the centrifugal end of the cell. The Golgi material and the nucleus, together with a few small granular mitochondria, are situated in the middle region of the cell, while the centripetal end is filled with clear cytoplasm which may contain a few small Golgi elements.

The accompanying illustrations are photomicrographs of two older oocytes. With the growth of the oocyte a layer of non-granular cytoplasm makes its appearance at the centrifugal pole (*(a)*, *N G*). At a later stage a layer of deeply stained material is present centripetal to the Golgi layer (*G*): this is identified as yolk (*Y*). In the mature oocyte the mitochondria (*M*) occupy the centrifugal half of the cell, while the Golgi material forms a thin layer centrifugal to the clear cytoplasm in the centripetal end of the cell (*C C*). As in the earlier stages, a few small Golgi elements may lie in the cytoplasm towards the centripetal pole. The yolk lies between the Golgi layer and the centripetal pole. At this stage the nucleus (not shown in the photomicrograph) is displaced towards the centrifugal end.

The presence of a non-granular layer at the centrifugal pole of oocytes of a certain age, and its absence from the young and from the mature oocytes, must be due to changes in viscosity correlated with the growth of the egg. It is also of interest that the position of the nucleus varies in eggs of different ages.

So far as I am aware, the only published work on the centrifuged mammalian egg is that of Beams and King[1], for the guinea pig egg. Beams and King do not mention a layer of non-granular cytoplasm at

the centrifugal pole at any stage in the development of the egg of the guinea pig, nor do they record a marked change in viscosity correlated with the growth of the oocyte.



(a) (b)

An examination of centrifuged oocytes of the mouse, fixed in formol and stained with Sudan IV, failed to reveal the presence of fat. The absence of fat from the mouse egg agrees with previous findings for the uncentrifuged oocyte[2].

This work was carried out at the University Zoological Department, Trinity College, Dublin.

R. A. R. Gresson.

Zoology Department,
University of Edinburgh.

[1] Beams, W. H., and King, R. L., *Cytologia*, **8**, 353–367 (1938).
[2] Gresson, R. A. R., *Quart. J. Micro. Sci.*, **75**, 697–721 (1933).

A Modified Phase Rule Equation

The interesting and useful modified phase rule equation recently proposed by Dr. S. T. Bowden[1] contains what he calls a restriction term, r, which "is equal to the number of pairs of phases having the same concentration or composition".

In applying the modified phase rule equation to one-component systems, however, it appears that r must be equal to the number of pairs of phases which are *identical*. Sublimation, fusion, evaporation and the triple point in one-component systems all involve pairs of phases which have the same concentration or composition. Now at the triple point, for example, Dr. Bowden's equation reads

$$3 + 0 + 0 = 1 + 2 - 3,$$

which is not correct. At the critical point of a pure substance, however, where the liquid and vapour phases are usually supposed to become identical[2], Dr. Bowden's equation reads correctly:

$$2 + 0 + 0 = 1 + 2 - 1.$$

George Novello Copley.

32 Lesseps Road,
Liverpool, 8.
Oct. 26.

[1] Nature, **141**, 331 (Feb. 19, 1938).
[2] See "Symposium on the Critical State, etc.", *Chemical Reviews*, **23**, 1 (1938); Traube, I., *Trans. Faraday Soc.*, **34**, 1234 (1938).

I am obliged to Mr. Copley for pointing out what appears to be an ambiguity in the use of the expression 'concentration' in the definition of the restriction term of the modified phase rule. Naturally, in the case of unary systems, the restriction term refers to identity of the phases and for a system at the triple point, $r = 0$, since the phases are not identical. Accordingly, we have

$$P + F + R = C + 2 - r$$
$$3 + F + 0 = 1 + 2 - 0,$$

which is correct. I made no reference to this simple example in my first communication because it is easily solved by means of the ordinary Gibbs equation.

Actually, the restriction term was defined to cover the more complicated cases, and it was taken for granted that the restriction referred to phase identity in all simple unary systems. At the time of writing, I was unaware that T. W. Richards[1] had also pointed out that much of the subtlety of the phase rule lies in the restrictions imposed on the system "when one individual is kept in a definite weight ratio or at a definite concentration in a variable phase". The matter is explained in more detail in my book on the phase rule[2], where for simplicity the expression 'identity restriction' is employed throughout.

Apart from the fact that the equation gives a correct interpretation of all the cases cited by Mr. Copley, I may add that its primary aim was to supply a more informative rule, capable of distinguishing between physical and chemical change.

S. T. Bowden.

University College,
Cardiff.
Oct. 31.

[1] *J. Amer. Chem. Soc.*, **38**, 983 (1916).
[2] "The Phase Rule and Phase Reactions" (Macmillan and Co., Ltd., 1938).

A New Decalcification Fluid

Decalcification of tissues by means of the usual acid reagents is rarely satisfactory, and unless carried out carefully and slowly the evolution of carbon dioxide leads to the production of artefacts. This disadvantage is particularly felt in dealing with the highly calcified integuments of some Crustacea.

To overcome the difficulty, tissues, after fixation, have been treated with aqueous solutions, in strengths up to 30 per cent of a neutral salt, of sodium hexametaphosphate. Complete decalcification of such a decapod as *Porcellana* (which would take at least a week in acid) was effected in a day and, since the reaction involved is a simple replacement of calcium by sodium, no distortion occurred. All the products of the reaction are water-soluble and are removed by washing in water:

$$2CaCO_3 + \underbrace{Na_2\{Na_4(PO_3)_6\}}_{\text{Sodium hexa-metaphosphate}} = 2Na_2CO_3 + Na_2\{Ca_2(PO_3)_6\}.$$

The method was also used on echinoderm and mollusc material and, although the process was slightly slower, the results were equally successful.

Mammalian bone was also softened, but the penetration was much slower. Despite the fact that the reagent is only water-soluble, it is sufficiently rapid in action not to cause maceration or damage to the tissues, and in all the material tested the histology was particularly excellent.

It should be emphasized that, as the salt is insoluble in alcohol, it must be well washed out, and the fixative employed before decalcification must be one which admits of this treatment.

R. A. C. Wilks.

Department of Zoology,
Birkbeck College,
London, E.C.4.
Sept. 27.

Binocular Illusion

In the correspondence on this subject, there does not appear to be mention of the faculty for viewing stereoscopic photographs possessed by those who can comply with Mr. J. D. Morton's manner of viewing a lattice[1].

In this case, as distinct from the binocular sequence described by Sir Richard Paget[2] and others, the eye axes are turned more nearly parallel than normally, while keeping the focus adjusted to the lattice distance. The 'suspended image' is then apparently behind the pattern.

Now this optical condition is that necessary for viewing a pair of stereoscopic photographs, without mechanical aid. My own eyes tend to move their axes apart more readily than to converge from the normal angle for focused vision at medium distances. They will even diverge about 1° out of parallel—shown by the fact that I can see a single binocular image formed by two similar objects 1 ft. apart, at a distance of about 50 ft. A pair of stereoscopic photographs are easily seen in correct 'perspective'—more easily than with a lens 'viewer' in fact.

The late Mr. R. C. Clinker, chief of the B.T.-H. Research Laboratory, was also endowed with this faculty, I believe, but I have not met many other persons who were.

G. R. R. Bray.

Walnut Tree Cottage,
Burlings Lane,
Knockholt,
Kent.

[1] Nature, **142**, 537 (Sept. 17, 1938).
[2] Nature, **142**, 77 (July 9, 1938).

Points from Foregoing Letters

A map showing the percentage distribution of the common guillemot, *Uria aalge*, having a white circle around the eye (bridled form), at various points around the coast of the British Isles, is submitted by H. N. Southern. The bridled form apparently depends on a single gene difference and the survey of its 'cline' gives important information as to the process of species differentiation.

The preparation of tellurium tetrafluoride, which on account of its reactive behaviour with glass and silica and its instability in the presence of traces of moisture had not been isolated previously, is described by G. A. R. Hartley, T. H. Henry and Prof. R. Whytlaw-Gray.

From the finding that the greater part of the sulphate (containing heavy oxygen for identification purposes) which had been injected into a rabbit was afterwards recovered unchanged in the rabbit's urine, A. H. W. Aten, jun. and Prof. G. Hevesy conclude that only a small part of the ingested sulphate ions exchange with the sulphate ions already present in the tissues.

The distribution of phosphorus in the leg bones of normal and rachitic chickens has been investigated by Dr. M. J. L. Dols and Prof. B. C. P. Jansen in collaboration with Prof. G. J. Sizoo and G. J. van der Maas. A radioactive isotope of phosphorus was used as an indicator. The phosphorus metabolism seems to be greater in the rachitic birds than in the normal chickens; and it is greater in the epiphysis than in the diaphysis of the same bone. These results were confirmed by radiographs.

From the cell-free solution of *B. fluorescens liquefaciens*, Prof. A. I. Virtanen and J. Erkama have obtained a mixture which seems to contain two new enzymes: one of these catalyses reversibly the reaction aspartic acid $\rightleftharpoons$ fumaric acid + ammonia, and the other leads, through hydrolysis, to the irreversible deamination of aspartic to malic acid.

Dr. Dorothy Wrinch describes a new procedure for deriving the crystal structure from the intensity maxima in X-ray diagrams, and shows how this can be applied in the case of insulin to derive from the 'vector diagrams' the cage structure based on the cyclol hypothesis.

A table showing the concentration of positive and negative ions in the air, as affected by air-conditioning in closed buildings, is given by Dr. F. Běhounek and J. Kletschka. There is a large temporary increase in the number of negative ions, due to the break up of water droplets, but this is soon reduced by the action of the walls and other objects in the room.

H. J. Groenewold finds that the maximum in the velocity of sound in helium I is connected with the rise of c_p/c_v above the λ-point.

Commenting on Prof. Scripture's statement that vowel sounds "cannot have been produced by resonance", Sir Richard Paget recalls some of the evidence in favour of the resonance hypothesis and offers the loan of some of his resonators to make 'profiles' of the artificial vowel sounds for comparison with those of human speech.

Dr. R. A. R. Gresson has centrifuged the ovaries of the mouse in the Beams ultra-centrifuge. The cytoplasmic inclusions and components of the oocytes are stratified according to their specific gravity. An examination of oocytes of different ages indicates that there are changes in viscosity correlated with the growth of the egg. Treatment with Sudan IV failed to reveal the presence of fat in the centrifuged egg of the mouse.

Mr. R. A. C. Wilks recommends sodium hexametaphosphate in aqueous solution as a decalcifying fluid. It acts rapidly and has the advantage over other fluids of replacing insoluble calcium by soluble sodium compounds without the evolution of gases, thus enabling delicate histological structures to be preserved without distortion.

Research Items

American Indian Place-Names

Dr. John P. Harrington has been engaged in an investigation of the origin and meaning of some well-known American place names of Indian derivation. A preliminary report issued by the Smithsonian Institution, Washington, deals with certain of his results. Utah, it has been assumed, generally was taken directly from the tribal name, the Utes, of the people who lived in this territory originally. This, however, was not their own name for themselves, but one bestowed upon them by the Navajos and Apaches. In Navajo linguistics, it would appear, the term is derived from the word for 'upper' and the name means 'the upper people', 'hill-dwellers' or 'highlanders'. Cheyenne is a direct derivation from the Sioux word meaning 'barbarian', or 'one who does not speak our language'. It may have conveyed dislike or contempt, as the Sioux regarded the Arapahos, Crows and others in the Cheyenne River valley as intruders into territory which did not belong to them. Tacoma is a mispronunciation of Puget Sound Indian for snowy mountain, 'Ta-ko-bed', a name applied to Mt. Ranier, Mt. Baker, Mt. Hood and Mt. McLaughlin, which early settlers mistook to be a specific name for Mt. Ranier. Seattle at present is unexplained. It derives directly from "Seh-Ahl", the name of an influential Indian at Lake Union, but names of individuals usually had some definite meaning. In this instance, it defies analysis. Manitoba is relatively easy. It means 'land of the spirit', and comes from the Algonquin word 'Manitoowa', meaning spirit. It was a generic term, identical with the term 'manitu' in eastern dialects.

Swineherds' Disease

E. Fried (*Thèse de Paris*, No. 139; 1938), who records three illustrative cases in men aged 27, 28 and 29 years, states that this new infectious disease, which is also called swineherds' benign meningitis, swineherds' meningo-typhoid and fruiterers' disease, has hitherto only been found in certain parts of France (Upper Savoy), Switzerland and Italy, where it has been described by Bouchet (1935), Müller (1932) and Penso (1934) respectively. It is an occupational disease which affects both sexes equally. The pig is the probable source of infection either directly by its dejecta or indirectly by an intermediate host such as the louse. The disease has been reproduced experimentally in man and in certain animals besides the pig, such as the rat, cat, ferret, monkey and mouse. The pathogenic agent is a filterable virus which is found in the blood between the second and sixth days of disease, and is eliminated in the urine and fæces. The cerebrospinal fluid is much less virulent than the blood. The virulence of the brain, spleen and liver has not yet been determined. The disease runs its course in three successive stages. The first is characterized by moderate fever, vomiting, diarrhœa and a polymorphous eruption. Then follows a period of remission in which the fever and other symptoms subside. In the third stage the temperature rises higher than before and a meningeal syndrome develops. Spontaneous recovery takes place, and no sequels ensue.

Nature of Lachrymatory Substance in Onions

According to Science Service, E. F. Kohman has suggested at a meeting of the American Chemical Society at Milwaukee, September 1938, that the lachrymatory substance in onions is aldehydic. Mr. Kohman suggests that these aldehydes may account for the putative value of the vegetable in cases of colds, as a palliative for rheumatism and arthritis, etc. Pre-treatment of the seeds with formaldehyde controls smut disease in onions; after planting, Kohman suggests that these aldehydes are developed, the onion itself thus maintaining its resistance.

Rodents from Galapagos Islands

The native species of Galapagos rodents belong to two closely related genera, *Oryzomys* and *Nesoryzomys*, of which all the endemic species known to occur in the island were represented in the California Academy of Sciences Expedition of 1905–6, with the one exception of *O. galapagoensis*, which has not been taken since Darwin's visit in 1835. Re-examination of the Expedition's collection by Robert T. Orr has brought several new facts to light (*Proc. California Acad. Sci.*, Ser. 4, 23, 303; Sept. 1938). Two examples of *N. darwini* from Indefatigable Island bring the known examples of that species in collections up to six. From James Island, from which no mammals had previously been recorded, four specimens of *Nesoryzomys* were obtained, and these present characters sufficiently distinct to warrant the creation of a new species, *N. swarthi*, which the author describes. The type specimens were collected in July 1906, and since more recent expeditions have failed to collect this species, the possibility exists that it may now be extinct as the result of competition with introduced Old-World rats. Examples of *Rattus rattus alexandrinus* were obtained on James Island during the visit which produced the native species.

Internal Fluid of Ascidian and Sea Water

The resemblance in composition between internal fluids and sea water is further illustrated by an analysis of the Pacific Ocean ascidian, *Chelyosoma siboja*, by Satarô Kobayashi (*Sci. Rep. Tôhoku Imp. Univ.*, Ser. 4, 13, 25; 1938). In this case the inorganic composition of the perivisceral fluid which surrounds the heart almost exactly corresponded with that of sea water at the Biological Station of Asamushi, although there were slight discrepancies as regards potassium and magnesium. The freezing point depression, 1·95, was also almost identical with that of sea water. On the other hand, the composition of the perivisceral fluid differed remarkably from that of the blood fluid (body fluid), especially of the corpuscle fluid as formerly described by the same author. The body fluid in the test arises from the blood vessels distributed in the test and in the soft body, and the blood sinus on the ventral side of the ascidian body is the connecting link between the two groups of vessels. Although in the cartilaginous test no trace of acid was detected, both test fluid and blood fluid gave an acid reaction, and the source of this acid appeared to be in the cell sap of the relatively large vacuolated vesicular cells in these fluids.

Cave Fauna of Yucatan

An interesting quarto memoir on this subject has recently appeared as Carnegie Institution of Washington Publication, No. 491 (June 1938). With an introduction by Mr. A. S. Pearse, of Duke University, there follow some twenty-three articles by a panel of specialists on the various animals collected in these caves, together with a short account of the fungal flora. The Yucatan caves, it may be added, were visited by Mr. Pearse in 1936. Altogether twenty-seven were examined, and most of them are of the so-called two-cycle solution type, and occur below ground-water level, being formed by the passage of water, which contains carbon dioxide, through limestone. Their form is irregular with high vaulted chambers and without evidence of streams or large pools. Some other of the Yucatan caves are evidently produced by faults while the limestone sheet which forms this peninsula was being elevated. More than three hundred species of animals were collected in these caves by Mr. Pearse, and of these 78 are described as new in papers in this memoir, as well as 19 new genera. About one tenth of the fauna encountered were troglobites or exclusively cave types. One fifth of the animals were troglophiles, or those which live in caves and may breed there but live outside also. The others were trogloscenes, or animals which occur in caves as accidental guests but may live indefinitely outside: these number about seven tenths of the fauna. Among the important troglobites of Yucatan are arthropods and vertebrates —shrimps, isopods, millipedes, chelonethids, spiders, collembolans, crickets, ants, together with a brotulid fish and a symbranchid eel.

Evolution of Annelida, Onychophora and Arthropoda

In an informative and stimulating publication, R. E. Snodgrass (*Smithsonian Misc. Coll.*, Aug. 1938) has set forth in considerable detail his views on the evolution of the Annelida, Onychophora and Arthropoda. To do this he has considered in sufficient detail to support his thesis and to allow of a discussion of metamerism, the development of non-specialized members of the three groups. Further, the structure of the adult is considered, system by system, fully enough to permit discussion of the homologies of various organs in the different groups and also those organs which, while superficially resembling one another, cannot be regarded as homologues. Certain lines of divergence from the generalized examples are also indicated. All this is done in a critical manner and illustrated by 54 figures, a number of which include as many as six or seven drawings, some original but most taken from other authorities. To document the statements, a reference list of 173 works is provided; this includes the most recent and the most important papers. The last part consists of what the author terms phylogenetic conclusions, and this occupies 16 pages and is divided into 25 paragraphs. Here are set out clearly and succinctly the deductions drawn from the data furnished in the preceding pages and a suggested phylogeny of the groups. The author postulates as an ancestral form a planula-like organism with a posterior blastopore. This by adopting a creeping habit is presumed to have become elongated, and as a result of creeping on the blastopore surface this aperture became correspondingly elongated. The mid-region of the slit then closed up, leaving an opening at each end, a subterminal mouth anteriorly and a terminal anus posteriorly, and connecting the two an alimentary canal. Henceforward the transformations into the three groups are followed by more close reference to actual developmental or adult conditions.

Soil Organisms and Seed-borne Pathogens

A brief but interesting note by A. W. Henry and J. A. Campbell (*Canadian J. Res.*, **16**, No. 9; Sept. 1938) directs attention to an aspect of the natural fauna and flora of the soil which is certainly not usually held in mind. Two diseases of flax, the browning caused by *Polyspora lini* and the anthracnose disease, *Colletotrichum lini*, are both frequently carried by infected seed. The authors supply very definite evidence that the infection of the crop from this source is much heavier when it is sown in sterilized soil than in untreated soil. The reduction in infection thus brought about by the natural action of other soil organisms is indeed more effective than pre-treatment of the seed with various sterilizing agencies, unless this treatment is so drastic as itself to reduce very considerably the germination of the seed. On the other hand, preliminary experiments with certain smut fungi, causing bunt of wheat, suggest that in this case the natural soil does not inactivate the seed-borne pathogens, so that the disease may be as prevalent upon plants grown in natural as in sterilized soil.

Zygnemales from Northern India

The slowly flowing streams of the plains of the Fyzabad District are rich in species of this group, and Randhawa has made a thorough survey over a period of two years (*Proc. Indian Acad. Sci.*, **8**, Sect. B; 1938). In streams which dry up during the hot weather, it is interesting to find that many species do not germinate until some months after the refilling of the water channels. The streams contain water from July onwards; a few species germinate at the end of August and are prolific by the end of September, but the majority of the species do not germinate until December. On this basis, the species fall into three groups: a small group of late autumn and early winter annuals, a large group of late winter and spring annuals, and a small group of ephemerals. This is summarized in a chart, which also shows the period of conjugation. An interesting species is *Zygnemopsis minutum*. The plant is filamentous, but the cells are loosely connected and fall apart prior to conjugation. The free floating cells meet and fuse in any direction, giving rise to zygospores of very varied forms. This species bridges the gap between Saccoderm desmids and filamentous Zygnemales. A useful survey of characteristics used for generic and specific identification precedes the description of the species.

New Records of the Larger Fungi

Mr. A. A. Pearson has cleared up several taxonomic puzzles of the larger Basidiomycetes, in a recent communication (*Trans. Brit. Mycol. Soc.*, **2**, Pts. 1 and 2, 27–46, Aug. 1938). Two new species are described, namely, *Tricholoma inocybeoides* and *Mycena uracea*, and both are illustrated in colour. Of most general mycological interest of Mr. Pearson's paper, however, will probably be his descriptions of various species of the genus *Russula* in relation to three chemical tests. Sulphovanillin, phenol and ferrous sulphate give distinctive colour reactions with many

species, and these are included in the descriptions of twelve uncommon kinds. Two species of *Inocybe* have been transferred to the genus *Astrosporina* by virtue of their spore characters. They are now *A. decipientoides* and *A. napipes*.

Insect Transmission of Maize Streak Virus

Some interesting results of experiments on insect transmission of maize streak virus have recently been published by H. H. Storey (*Proc. Roy. Soc.*, B, **125**, 455–477; Aug. 1938). Special attention has been given to the part played by puncture of the plant's tissues by the insect *Cicadulina mbila*, in transmission. It seems necessary, in this particular host-virus combination, for the insect's proboscis to reach the phloem tissue in the host, and infections fail if this degree of penetration is prevented artificially. Punctures maintained for less than 5 min. fail to infect, and it is concluded that the insect inoculates virus in distinct doses. Each dose appears to be independent in its effect of any other doses inoculated by the same or another insect. The vector can take up virus from the mesophyll in a chlorotic area of a diseased leaf, but cannot take it up from either the mesophyll or phloem of a green area. Probability of infection, moreover, is not diminished by the removal of inoculated leaf tissue shortly after the inoculation, so the virus must spread with considerable initial rapidity.

Boundary Waves at a Surface of Discontinuity

Prof. K. Sezawa and K. Kanai, in a very valuable paper (*Bull. Earthquake Res. Inst., Tokyo Imp. Univ.*, **16**, Pt. 3; Sept. 1938), have recently followed up the work of Stoneley on Love and Rayleigh waves (*Proc. Roy. Soc.*, A, **106**) by discussing the formation of such boundary waves. In this, they have used a method of calculation similar to that employed by A. Sommerfeld (*Ann. Phys.*, **4**, 28; 1909), and make the problem two-dimensional. They obtain equations for dilatational waves, distortional waves in a horizontal plane, and distortional waves in a vertical plane, paying particular attention to the amplitudes of such waves at both large and small epicentral distances. One outcome is that larger amplitudes are to be expected in the horizontal distortional waves than in the other two at all epicentral distances. A second is that in the case of dilatational primary waves and distortional primary waves with amplitudes orientated in a vertical plane, the energy of the body waves is converted usually into boundary waves in passing through or in being reflected from a surface of discontinuity. In the case of distortional waves with amplitudes orientated horizontally, no boundary wave is formed. A third is that the large amplitudes of S_cS which sometimes exist may be explained on the above theory. Sezawa and Kanai modestly say that their present work is really only qualitative and that they are investigating the three-dimensional problem more rigorously.

Corresponding States

In a discussion of an equation of practical interest for gases removed from the ideal state, F. G. Keyes (*J. Amer. Chem. Soc.*, **60**, 1761; 1938) has examined the equation $B_\theta p_c/T_c = -R\theta f(\theta)$, where p_c, T_c are the critical pressure and temperature, $\theta = T/T_c$ is the reduced temperature, and $B_\theta = \beta - A/RT - (\alpha^2)A^2/(RT)^2\beta^2$, where A, β are constants, α^2 is a quantity which may vary from substance to substance. It is suggested that

$$B_{\theta 0} = \beta_\theta - A_\theta/\theta - C_\theta/\theta^3$$

where β_θ, A_θ and C_θ are expected to be the same regardless of substance. This has been shown to be the case for a number of different substances, but the value of C_θ is different for non-polar and polar substances. It is noteworthy that the constants are derived from values of the van der Waals constants, and hence the van der Waals type of molecular field is assumed to be valid. It is shown that the reduced equation is useful in making approximate physico-chemical calculations involving gases under pressure.

Specific Heat—Temperature Relationship of Certain Steels

At the adjourned autumn meeting of the Iron and Steel Institute a paper of very considerable importance was presented by Dr. C. Sykes and Mr. H. Evans. For many years past, there has been evidence that in commercial iron and steel certain abnormalities occur at temperatures below the carbon change point. Dearden and Naesar have found such abnormalities in the specific heat relationship at 120° C. Using a very delicate method, Sykes and Evans have failed to find this point, and it must be accepted that, at any rate in the materials with which they have dealt, no such abnormality occurs in the specific heat. With the exception of a slight deviation at the temperature at which the iron carbide becomes non-magnetic, all their curves, both for iron and for carbon steels, are smooth. By introducing into their test pieces small amounts of low melting point metals of known latent heat, they have proved that changes of the order of those previously observed could not have been missed with the experimental technique which they have employed. It is pointed out, however, that these results are not necessarily incompatible with abnormal changes in the mechanical properties of the materials.

New Diffraction Gratings

Prof. R. W. Ditchburn, of the University of Dublin, has recently discussed the problem of diffraction by gratings with irregular spacings and finds that they may be designed so as to give with fewer elements the same resolving power as gratings with equal spacings (*Proc. Roy. Irish Acad.*, **44**, A; 1938). For echelon gratings with an even number of plates, each plate of thickness a small multiple of a fundamental thickness, and the plates equidistant from the middle plane of the grating of the same thickness, he shows that the diffraction pattern produced may be predicted without much difficulty. Thus for an echelon which would normally have 56 plates, if each 13th plate from the centre plane be of the normal width but of 7 times the normal thickness so that it replaces plates 7 to 13, the 20th plate and the 27th plate of three times normal, and the inner part of each widened step be covered by an opaque screen which reduces the transmission width of the step to the normal width, the resolving power of the 36-plate echelon produced is equal to that of a 65-plate echelon of the usual type. A similar improvement of the plane ruled grating is produced by ruling groups of about 50 lines with the centres of the groups at certain irregular specified distances apart, which leave unruled spaces between groups, and the unruled spaces are covered by screens; 60 per cent of the ruling is saved and the resolving power of the grating is increased 10 per cent.

The Present Position of Sociology*

IN considering the achievement of sociology, the principal problems can be set out under four heads.

Social Morphology, including (1) the quantity and quality of the population in so far as this affects social relations and the character of social groups, and (2) social structure, that is, the classification and analysis of the principal types of social groups and social institutions.

On the qualitative side, early studies were dominated by the hypothesis of racial differences in mental character without realization of its difficulties. Their successors are represented by the eugenists and the numerous race theories of civilization, although it is probable that culture is independent of race, and that changes in social structure do not depend on changes in inherited structure. It would appear from studies of the distribution of intelligence in the various social groups that there is no conclusive evidence of genetic difference between the social classes. A good deal of work has been done on the question whether the existing difference in fertility among various social groups is likely to affect the inborn constitution of the stock. Since the differences between the groups are not genetic, the dangers of deterioration on this score are not great. There is no reason to believe that the lower social grades are being drained of ability through the operation of the social ladder. Studies of social mobility lead to the conclusion that conditions making for greater mobility would also make for greater equality in the distribution of wealth, and differential fertility, so far as it is conditioned by varying standards of life, would tend to disappear. A social system which is based on justice and equity would, on the hypothesis of genetic differences, be the most eugenic of agencies.

The subject of social stratification has recently attracted attention widely. It is now possible to give estimates of the proportions of the social classes in the different European countries. The proportion of middle class in Germany is about 34 per cent of the occupied population, in France about 40 per cent, and in England about 25 per cent, though these figures are not comparable, owing among other things to the differences in the number of peasant proprietors in these countries; while in England since 1881 the ratio of increases of the middle class is placed by Prof. Bowley at 100 : 195, as against an estimate of the ratio of increases of the working classes of 100 : 168—an interesting commentary on the theory sometimes urged that the middle class is in process of elimination. An interesting result of recent studies in social mobility is the relatively caste-like character of the higher ranges in the world of business. In Germany, in the main, big industrialists, big business leaders, and big landowners are self-recruited; while in America, too, big business is increasingly self-recruited, and tends to become caste-like, the self-made man now being rare. It is generally recognized that one of the major sources of instability in modern democracy is to be found in group conflicts represented in the multiplication of political parties and in the drastic measures taken in authoritarian countries to abolish all parties save one. The position of the middle classes is of special importance in this connexion, as is the whole problem of occupational restratification, which has evidently been going on in Europe since the Great War.

Social Control. The sociology of social control is at bottom part of the sociology of social structure, since clearly a great deal of the structure of society consists in the norms regulating and controlling behaviour in law, morals, religion, conventions and fashion. To the sociologist, the most important types of problem are the differentiating characters of the norms, the conditions under which they arise, and their influence on social conditions and on one another, while important psychological problems are connected with all.

There are many who think that the chief difficulties that confront the modern world in the effort to bring about some form of unity among classes and peoples are due to different valuations that are found among them. Others hold, on the contrary, that with regard to the fundamental ends of life there is general agreement, and that the clash of contradictory opinions relates rather to the means which have to be adopted in order to attain these ends. It is surely of the greatest importance to ascertain wherein the difference really arises, and this is not possible without a careful study of the actual beliefs and behaviour of individuals and groups, and a careful discrimination of the factual from the valuational components of moral judgements.

Social Process. In evolutionary sociology, among points which appear important are: First, that sociologists have not yet succeeded in establishing any general laws of social evolution, though this is not to say that significant trends do not occur. There has been, for example, an enormous process of unification, including increase in the size of political aggregates and in intercommunication and interdependence, political and economic, and possibly, despite cultural diversity, an underlying assimilation, or convergence, in science, art, religion, and culture. Secondly, there is an increase in the command of the conditions of life, intensified by increasing knowledge of Nature, including mind and society. Thirdly, various experiments have been made in reconciling order with freedom, and there has emerged in the consciousness of man the sense of the unity of mankind and the need for reconciling the requirements of order and liberty on a world-scale. Fourthly, if development has occurred in the history of humanity, it has certainly not been automatic or rectilinear, and its continuance in a given direction is not secured. Fifthly, if development has occurred, it has been uneven, and advance in one direction has often constituted a hindrance to advance in others.

Increase in the scale of organization has often been achieved at the cost of freedom, and collective efficiency may result in stultifying and thwarting the deepest needs of individuals. The growth of

* Substance of a paper by Prof. M. Ginsberg to Section F (Economics) at the Cambridge meeting of the British Association, read on August 19, 1938.

knowledge and the command over the conditions of life has also been extremely uneven. Our powers over inorganic Nature are much greater than our powers over life, mind and society; and since the former may be used for purposes of destruction, there is danger that before mankind has acquired sufficient knowledge of the causes of social change, and sufficient moral wisdom to use it aright, the whole structure may be wrecked, and the work of organizing mankind may have to be begun all over again. Scale of organization is of especial importance at the present time.

Self-development even on the part of large communities is becoming more difficult and precarious. This infinitely complicates the problem of reconciling order with freedom. Both logical and historical analysis suggest that efficient control over the forces of external Nature and of the inner nature of man must rest upon an organization on a world scale, and must rely on methods which can call forth the spontaneous responses of all its members in the service of ends they can recognize as common.

Social Pathology. This brings out the complexity of social causation and the importance of bringing together the results of different modes of investigating and interpreting social phenomena. Taking one example only, the study of cause of crime has to be approached by way of broad social and economic studies, such as (1) correlating various types of crime with social and economic variables, such as price-rate of commodities, density of population, rural and urban conditions of life, etc.; (2) genetic studies; and (3) individual case-study, to which belong therapeutic methods of psychopathology. So little has been done to view the facts in relation one to another, that at different times undue prominence has been given to one or other factor in the causation of crime. To the sociologist taking a broad view it is clear that no invariant relation can be established between any single factor and crime, while these factors in themselves are complex and by no means independent. There are signs that the sociological method of approach is beginning to influence the study of crime both in Great Britain and in the United States.

Agricultural Research in India*

THE Imperial Council of Agricultural Research was set up as a result of the Royal Commission on Agriculture in India in 1926. One of the conditions laid down was that the Council's activities should be periodically reviewed by some disinterested expert, and in 1936 Sir John Russell was invited to make an extensive tour of the provinces with this end in view, in so far as plant industry was concerned.

Sir John's report has now been published. The volume is divided into two parts, the first of which describes the type of agriculture, the crops and the factors which make for improvement in their yield, the special difficulties confronting Indian agriculture and the machinery for dealing with them. In the second part of the report, the various research schemes fostered by the Council and in progress throughout the country are described in detail.

Agriculture in India is not merely an industry but also the mode of life of a large part of the population, and in consequence the scope of the Council's activities is of a far-reaching nature. Village improvement is in fact an essential preliminary to any fundamental advance in agriculture. The gulf that separates the experiment stations and the few large-scale farmers from the peasants, who cultivate the largest proportion of the land, needs to be bridged, and this is rendered peculiarly difficult to effect owing to the absence of the educated middle class farmers, who form such an important section of the farming community of the West.

A vast amount of pioneering work has been successfully accomplished by the Council since its formation, and the necessary extension now lies in the co-ordination of theory with practice, that is, work in the field rather than in the laboratory, increased productiveness being always the central problem. The great increase in the area under cash crops such as cotton, sugar cane and tea, compared with that under food crops, is one of the most remarkable features of modern Indian agriculture, and although much progress has been made both in their production and utilization, particularly in the case of sugar cane, greater co-operation with the buyers is desirable. Advances in this direction have already been made in the case of cotton and tea, as each crop has its own research station, which is in touch with the appropriate buyers. Similarly, work on food crops needs to be carried out in association with nutrition experts, and inquiries made into the possibilities of extending dairy husbandry and fruit and vegetable growing, if diet is to be raised to a more satisfactory level.

In view of the supreme importance of water supply, the establishment of a separate research institute for the study of irrigation and water relationships between soil and crops is deemed desirable. The proper unification of dry farming schemes is, of course, equally important. Questions concerning soil erosion and alkali trouble might well be dealt with by a soil conservation committee, which could also usefully collect and collate results of manurial trials and soil analyses. Similarly, matters relating to crop planning schemes and insect and fungus pests might be in the hands of a crop production committee, which would provide a convenient central body for co-ordination. Special problems such as locust control, on the other hand, need their own organization, and in spite of the fact that invasions only occur sporadically, a permanent service seems eminently desirable, so that immediate action may be taken when the need arises. The Imperial Agricultural Research Institute recently opened at New Delhi will, no doubt, play a specially important part in the co-ordination of the Council's schemes, and its programme be largely determined by the most pressing problems of the moment. A number of questions to which it could usefully give attention are suggested in the report.

* Report on the Work of the Imperial Council of Agricultural Research in Applying Science to Crop Production in India. (Delhi: Manager of Publications, 1937.)

During his tour, Sir John Russell visited more than forty experiment stations and inspected nearly ninety research schemes, in most cases discussing the work with the individual in charge. The posts under the Council's schemes are of temporary nature only and a plea is made for the provision of a number of permanent appointments, to be filled gradually by selected investigators of proved ability. By this means, specially experienced men would be available to deal with difficult problems at the various stations, where local resources were inadequate. Such a scheme would inevitably necessitate an increase in the financial grant made to the Council, but the return in enhanced efficiency would seem to justify this.

Much of the research in agricultural science in India is not so widely known as it deserves to be, due largely to the practice of publishing results in a number of small communications. The preparation of a series of monographs by competent persons is suggested, setting forth the results obtained by Indian workers and pointing out how they differ from those obtained elsewhere. Such publications would greatly raise the prestige of Indian research work and also prove of value to teachers and research workers throughout India itself.

Radio Transmission and the Ionosphere

MARCONI'S discovery that radio waves followed the curvature of the earth indicated that the signals were reflected back to earth by an electrified condition of the upper atmosphere. In 1925 Prof. E. V. Appleton in England and Breit and Tuve of the Carnegie Institution (U.S.A.) gave definite experimental demonstrations of the existence of such a mirror.

Since these experiments were made, research on the electrified region of the atmosphere, called the ionosphere, has made great progress. It is now known that several distinct layers of ionization exist. The first, called the E layer, is at a height of about sixty miles and is capable of reflecting fairly long waves. The second, called the F_1 layer, is capable of reflecting shorter waves, at a height of about 120 miles, and the third, the F_2 layer, reflects still shorter waves at a height of about 180 miles. The ability of these layers to reflect radio waves depends on the number of electrified particles present, either electrons or electrified air molecules. In an article communicated to the *Radio Review of Australia* of June by a member of the staff of the Carnegie Institution, it is described how the ionosphere affects radio transmission.

The author refers to the recent discovery by Dr. J. B. Dellinger, of the U.S. Bureau of Standards, of sudden fade-outs of high-frequency radio signals on the daylight side of the earth, and that these fade-outs were connected with the hydrogen prominences which sometimes appear on the sun. It is believed that all these fade-outs occur simultaneously with solar eruptions. When a fade-out occurs, no reflections are obtained from the E, F or F_1 layers. It is just as if one were looking into a looking glass and suddenly the reflection disappeared. The cloud of electrons which prevent the waves being transmitted may be considered as a 'blanket' covering the entire daylight hemisphere of the earth at a height of 40–60 miles.

A very pronounced fade-out occurred in April 1936; a sudden brightening was observed in the region around a spot on the sun. One minute later radio reflections from the ionosphere ceased and a large change also occurred in the earth's magnetism and in the earth currents. The heights of the reflecting layers recorded at the Carnegie Institution's observatories in Peru and Western Australia and by other organizations, serve to indicate the nature of the effects produced.

The improved quality of the ionosphere during times of sunspot activity makes a greater range of wave-lengths available for long-distance transmission. Unfortunately, times of sunspot maximum are most favourable for the occurrence of magnetic storms. These storms are believed to be due to swarms of ions and neutral corpuscles ejected from the sun with such speed that they reach the earth in about a day. Impinging on the atmosphere, these corpuscles give rise to auroral displays in high latitudes and seriously impair radio communication, when the path of the radio waves passes close to the radio zone—a region about 20° from the geo-magnetic pole. Most of the radio traffic between the United States and Europe traverses such a path, with the result that on days of great magnetic disturbances those radio circuits are never available.

On the other hand, radio traffic between the United States and points in South America is not seriously impaired by magnetic disturbance. An ingenious application of this fact was made by one of the commercial companies during the severe magnetic disturbances on April 24–28, 1937. Radio messages intended for European points were 'routed' through the company's station in South America and retransmitted to Europe, with the result that communication was maintained throughout the disturbance.

Another interesting application of scientific knowledge concerns the scheduling of trans-Atlantic broadcast programmes. Research has shown that times of magnetic disturbances tend to recur at 27-day intervals, corresponding to the period of rotation of the sun. On this basis, it is possible to predict a month or two in advance the days that are likely to be unsatisfactory for long-distance transmission and the days that are likely to be satisfactory. International broadcasts, scheduled for pick-up by one of the large networks, are arranged so far as possible to come when no magnetic storms are expected.

The means by which magnetic storms affect radio transmission is not clearly understood. The effects of magnetic storms on radio transmission are markedly different from the effects produced by the ultra-violet light from solar prominences. While storm effects are most strongly manifested in high latitudes, the fade-outs are most pronounced near the equator. Furthermore, the fade-outs occur only during daylight hours, while the storms disturb radio transmission on both the day and the night sides of the earth.

Acid and Basic Open-Hearth Steel-making Practice

THE annual meeting of the Iron and Steel Institute held on May 4–6 was devoted to a general discussion of open-hearth steel-making practice. A very large amount of data was brought together from all of the main steel-producing areas of the British Isles, and this material is most excellently summarized. As a result, it has been possible to determine in a manner hitherto impracticable the main factors on which high furnace efficiency depends.

It is confirmed that, within the working limits imposed by the refractory materials, etc., the output of a furnace is directly proportional to the heat input. For furnaces producing ordinary commercial steels, an average of 2 lb. of steel per hour per therm may be expected in the case of fixed furnaces and 1·6 lb. for tilting furnaces. Large furnaces of the latter type show the lowest output of any of those examined, probably on account of the long period of refining required with the high percentages of hot metal employed. On the other hand, such furnaces have the advantage of a much lower consumption of refractory materials than obtains with other types of furnace.

For furnaces of normal port design, a high ratio of the velocity of the gas to the air gives the best performance, which requires that the area of the air port should be at least six times that of the gas port. Where this adequate gas/air velocity is obtained, conventional designs of the ports have given results which are as good as those obtainable with special constructions. Whilst the relative area of the hearth should be large when high proportions of scrap are being used, this factor of design is dependent on that of the ports and on the direction of the flame. On the other hand, when the percentage of hot metal is high and of high metalloid content, deeper baths are employed with correspondingly reduced areas of hearth.

The highest rates of production are shown to be obtained from basic, hot-metal, fixed furnaces, averaging 7·53 tons per hour per 100 tons capacity, a figure which may be compared with 7·46, 6·49 and 5·78 tons per hour for basic, cold-metal fixed; acid cold-metal fixed; and basic hot-metal tilting furnaces respectively. They have, however, a higher average total heat consumption per ton of 86·2 therms as compared with averages of 82·8, 84·6 and 76·7 therms per ton for the other types.

"With our ever-increasing knowledge of the subject the physical chemistry of steelmaking has become of great importance in the operations of steel manufacture, and there are few sections of the industry to-day which have not benefited from the wider appreciation of the possibilities of this branch of applied science." Thus Dr. McCance introduces his paper on the application of physical chemistry to steel-making, in which he surveys the work done by himself and others in Great Britain, the United States and Germany. Starting with a general discussion of the basis on which this work has been built, the paper proceeds to direct attention to the more important conclusions already reached which have a direct bearing on the practice of steel-making by the open-hearth processes. The reduction of oxides by carbon; the manganese and silicon reactions; the reduction of manganous oxide by silicon; the reactions due to sulphur compounds and those in which phosphorus are involved are considered in turn, together with the question of ingot cracking.

Although the paper is unsuitable for further condensation here, it may be said without fear of contradiction that it represents the most substantial attempt ever made to consider any process of metallurgical production on a really scientific basis.

F. C. T.

Scientific and Industrial Research in Canada

THE twentieth annual report of the National Research Council, Canada, covering the year 1936–1937*, contains the report of the president of the Council as well as reports from the various divisions. Even the president's brief review of the organization of research, both pure and industrial, indicates that the work of the Council makes contributions to the progress of industry in Canada comparable with the contribution of the Department of Scientific and Industrial Research in Great Britain. The Division of Biology and Agriculture is devoting considerable attention to studies in the storage and transport of food. Valuable information obtained by visits to Europe during the year is being applied to the improvement of export trade arrangements. Simple and rapid methods have been worked out by the Division for determining the probable effectiveness of weed killers by their effect on the rate of growth of plants in water culture. A new method of experimental malting has been developed which seems to give the true value of varieties of barley, even though these require widely different malting conditions to give the best results. A new paper box packing has been developed for storing and shipping poultry, which can be sealed conveniently to prevent loss of moisture and the danger of freezer-burn. Apparatus has been developed for accurate measurement of atmospheric humidity at low temperatures and when only small amounts of moisture are present in the air. Work has been carried out on the relation of bacteria to the curing and to the uniformity of cured bacon, and other work has been carried out by the Division on the baking quality of wheat and in co-operation with the Canadian National Railways on a method of heating refrigerator cars which has led to the development of an underslung charcoal heater.

The Division of Chemistry has developed a relatively cheap synthesis for α-naphthylacetic acid as well as methods for the synthesis of indolyl-butyric acid and indolyl-acetic acid. A fundamental study is being made of the problem of corrosion, and further

* Twentieth Annual Report of the National Research Council, 1936–1937. Pp. 182. (Ottawa: National Research Council of Canada, 1938.) 75 cents.

work has been carried out on the novel form of distillation, which was invented by the Division, arrangements having been made for the manufacture of the gauze packing. Research on plastic casein has also been undertaken and research on the preparation and properties of carbon black from waste gases from the pyrolysis of natural gas has been concluded, while further work has been carried out on the preparation of carbon black by the channel process. Work on the use of formalin for the disinfection of seed wheat has been extended to include the study of many organic compounds as seed disinfectants. Good progress is reported in work on the fundamental laundrying operation bleaching, as well as in work on the fading of dyed textiles in sunlight, determination of damage to silk by a viscosity method and the regain of raw wool.

In the Division of Mechanical Engineering, the Aerodynamic Laboratory has carried out tests on models of three service aircraft in the wind tunnel to prove the accuracy of prediction of the performance of aircraft from the results of wind tunnel tests. Comprehensive wind tunnel tests have also been made for a Canadian aircraft building firm in connexion with the development of an aeroplane being designed specifically for commercial service in Canada. Measurement of hydrodynamic forces on stop logs for emergency dams in ship canals was a new and interesting study commenced during the year. Other problems under investigation include the work on fire hazard testing, farm windmills, gasolene specifications, aircraft instruments and the inspection and labelling of oil burners. The Division of Physics and Electrical Engineering has undertaken fundamental work on light, sound, heat and electricity as well as standardization in these and in related fields. The development of an improved and highly satisfactory means of heating refrigerator cars in winter which makes it possible to maintain uniform temperatures in the cars is now being taken up commercially. Studies in heat transfer are being applied to the tests in insulating material and to the investigation of heat conservation qualities of textiles used for clothing. Tests are also being made to determine the sound absorptive properties of building materials and the proper design of rooms for the best acoustical effects. Other experiments have been concerned with electrical methods of packing poultry in preparation for marketing. A second cathode-ray direction finder was built during the summer, and a development programme to adapt this type of radio direction finder to commercial service has been undertaken.

In addition to the work of the various Divisions, important work has been carried out through the joint or associate committees, including research on the breeding of rapid growing rust-resistant strains of wheat, oil seeds research, feeding-stuffs research, investigations on seed treatment with formaldehyde, on the effect of environmental factors on wool, on deficiency diseases of sheep, on asbestos, etc. The Associate Committee of Parasitology has been responsible for studies of liver fluke disease, warble fly eradication, anthelmintics, etc.

Explorations of the Smithsonian Institution, 1937

IN the annual review of the research activities in the field of the Smithsonian Institution, Washington, D.C. ("Explorations and Field-Work of the Smithsonian Institution in 1937". Pp. 122), a preliminary announcement is made of the results of twenty-four expeditions, for the most part in geology, biology and anthropology. Some of these were financed wholly by the Institution, others were co-operative undertakings with institutions interested in the promotion of these respective branches of science. Most of the expeditions in 1937 were within the American continent, including the West Indies. Of the expeditions to other continental areas, Mr. H. G. Deignan describes an exploring expedition to Siam for the purpose of observing and collecting specimens of the fauna.

An expedition to the East Indies in conjunction with the National Geographic Society led by Dr. W. M. Mann visited Sumatra, Amboina, the New Guinea coast, Java, and Singapore, collecting living animals, birds and reptiles for the National Zoological Park. The minerals of Russia were investigated by Mr. E. P. Henderson, who visited the Kola Peninsula before attending the International Geological Congress at Moscow. The American expeditions and investigations included catching walrus pups in Greenland and moose hunting in Alaska, collecting insects in the West Indies and Virginia, fossils in Michigan, Utah, Arizona and elsewhere, and studies of the Montagnais-Naskapi Indians of the St. Lawrence river.

Among the archæological investigations an account is given by Mr. David I. Bushnell, jun., of an ancient site on the banks of the Rapahannock in Virginia, exposed by flood water in the early months of 1937, which produced stone implements of varied types and pottery bearing the impression of coiled backetry, considered to be the oldest form of pottery found in the Rapahannock valley. Other village sites of a similar character, and exposed by the same agency, were visited, which suggest that much instructive evidence would be obtained by systematic excavation. Further investigations on the Lindenmeier stone age habitation site in northern Colorado have produced evidence of importance relating to Folsom man, though the skeletal remains of this early type of man in America still evade search. Dr. F. H. H. Roberts, jun., who describes the results of his investigations here in 1937, records the discovery of a number of anvil stones still *in situ*, on which Folsom man manufactured his implements and cracked bones for marrow, as is shown by the fragments of various kinds of stone and bone found in the surrounding ground. The stratified deposits show that the site was occupied after the climax of the Wisconsin period, but within the late Glacial, when a colder and moister climate, which was responsible for the heavy soil zone overlying the evidence of occupation, was approaching. Dr. Aleš Hrdlička adds details relating to his investigations in the Aleutian islands of the problem of the migration of early man into America further to those already reported (see NATURE, 140, 577).

Science News a Century Ago

Methods of Using the Theodolite

Before the Society of Arts for Scotland, on November 28, 1838, Edward Sang, a civil engineer and machine maker of Edinburgh, read a "Notice of an Erroneous Method of using the Theodolite with a Strict Analysis of Various Arrangement of Readers". When conversing with one who had been engaged on the Ordnance Survey, Sang learned of a peculiar arrangement of the readers which existed in some of the instruments used. Expressing the opinion that the method was erroneous, he developed an analysis and submitted it that it might help to remove that blind reliance on the authority of names which was too prevalent. The errors, he said, would not visibly affect maps of counties but they were high enough to render inaccurate determinations of the degree of meridian. In the course of his paper, he said: "Mere opinion has too long held the place of accurate study in the construction of angular instruments. In particular, the question whether the method of repetition or that of frequent readings, be preferable, had been discussed with almost national warmth. Repeated observations were French, single observations were English, as if there be national scientific creeds."

The Botanical Society

At the anniversary meeting of the Botanical Society, held on November 29, 1838, the report of the council showed that 48 members had been elected since the last anniversary and the total number was 98. The number of British plants received amounted to 18,592 specimens, including 1,050 species. The foreign plants received amounted to about 10,000 specimens including about 4,000 species. The distribution of British plants, it was stated, would take place in January, when each member would receive such of his desiderata as were in the herbarium, in proportion to his contribution.

The Royal Society

At the anniversary meeting of the Royal Society on November 30, 1838, the Marquis of Northampton was elected president, while Sir John William Lubbock was elected treasurer, Roget and Christie, secretaries and Capt. W. H. Smyth, foreign secretary. The Copley Medal was awarded to Faraday, the Rumford Medal to J. D. Forbes, and the Royal Medals to H. Fox Talbot and Thomas Graham.

Macroscelides

"The curious insectivorous mammal called macroscelides," said the *Athenæum* of December 1, 1838, "which inhabits the rocky mountains of the western part of the district of Algeria, has recently been observed by M. Wagner. It inhabits the crevices of rocks, and makes its bed in the underwood of the dwarf palm; it eats the larvæ of insects, grasshoppers and terrestrial mollusca, introducing its rostrum into the snail shells before the animal has time to retreat. It is remarkably gentle, only expressing uneasiness by a low sound, something like a sigh. It raises itself on its hind legs when it hears any sudden noise, and also leaps upon its prey, but never walks solely on two legs like the Jerbra. It disappears in the rainy season, and during the great heat."

Societies and Academies

Paris

Academy of Sciences (*C.R.*, 207, 693–752, Oct. 24, 1938).

D. Riabouchinsky: Supersonic analogy of the electromagnetic field.

L. Roy: Analogy between the forces exerted on currents and magnetic forces.

J. Cabannes: Water of crystallization of gypsum. Examination of a single crystal in ordinary light shows valency oscillations of the molecule H_2O without the complications of liquid water.

M. Lugeon: Geological observations in Antolia.

W. Doeblin: Kolmogoroff's equation.

G. Tzitzeica: Certain deformations of superior order.

G. Pólya: Indetermination of a problem akin to the problem of moments.

S. Bergmann and M. Schiffer: Bounded families of functions of two complex variables in domains with a *surface remarquable*.

G. Roux: Measurements of the intensity of gravity in Morocco. A Holweck-Lejay pendulum was used.

O. Sing-Mo: A theorem of Lord Rayleigh [relating to the stability of fluid movements].

L. Reingold: Energy study of combustion at constant volume: imaginary and real combustion.

T. De Donder and J. Géhéniau: Internal tensions and the dynamics of the radiating electron.

P. Barchewitz and G. Costeanu: Absorption spectra in the very near infra-red (6,000–10,000 A.) of ammonium salts.

B. Kwal: Initiation of an ephemeral electric discharge by ionizing radiation in tubes with plane parallel electrodes.

G. Brooks: Relation between fluorescence and the chemical constitution of laccol, moreacol and their derivatives. These polyphenols represent a new type of fluorescent body in which fluorescence is connected with the double bond of the C_{15} side-chain.

Mme. M. Freymann, R. Freymann and Y. Ta: Absorption spectra in the near infra-red and Raman spectra of ammonium salts.

A. Lassieur: Apparatus for the microdosage of carbon in ferrous metallurgical products.

C.-K. Lin: Structure and absorption of benzoylbenzoic acid and its derivatives.

R. Duschinsky: Rotatory power of citrulline; synthesis of the optically active product.

J. Fejfer and M. Jahoda: Double crystal spectrometer with photographic registration, and the measurement of the imperfection of crystals.

J.-P. and P. Destombes: The Albian of Pays de Bray.

P. Lesage: Researches on the inheritance of acquired physiological characters: precocity. Continuation of experiments with *Lepidium sativum* which maintain early development acquired at a higher temperature when grown at a lower temperature. Similar results were obtained with a dwarf pea.

Mlle. V. Kovarsky: Is it necessary to re-educate left-handed persons? Examination of 2,500 children leads to the view that left-handedness is a natural phenomenon which does not imply any inferiority, and attempts should not be made to enforce right-handedness.

H. BULLIARD, I. GRUNDLAND and A. MOUSSA: Detection of the phosphorus of supra-renal phosphatides by radio-phosphorus. Thin sections of tissue are allowed to act on radiological film, which shows the area affected by the radio-phosphorus.

E. KAHANE and MLLE. J. LÉVY: Water-soluble choline of invertebrates: study of the limpet (*Patella vulgata*).

S. NICOLAU: Data on the morphology of the virus of yellow fever and the morphogenesis of the inclusions which it provokes in the tissues.

Budapest

Hungarian Academy of Sciences, October 24.

G. RADOS: Deduced substitution of unitary substitution.

K. SCHAFFER: Finer anatomy of the cerebellum region of the pyramidal path.

A. ZIMMERMANN: Functional structure of the fasciæ.

F. KONEK: Alkaloid betains (1). The α-betain of chinin and chinidin.

G. ZIMMERMANN: Comparative anatomy and embryology of the omentum.

K. SASVÁRI: Fourier analysis of the crystal structure of $AgMnO_4$.

L. BUZA: Dissolution of the blood cell by the leprous bacilli.

I. LIPKA: Zero points of power series (2).

Cape Town

Royal Society of South Africa, October 19.

A. J. H. GOODWIN: Skull thickness and external measurements in relation to capacity. Research detailing the relationship of skull thickness to internal capacity was described. It was pointed out that skull thickness varies from 2·3 mm. average, to 8·3 mm., with a difference in the region of three per cent of capacity for each millimetre of skull thickness. Maximum length, plus width, plus supra-auricular height is employed in relation to skull thickness, to determine internal capacity.

P. J. G. DE VOS: Production of secondary rays in copper by cosmic radiation. Cosmic rays produce showers of secondary rays in any matter traversed. The density of this secondary radiation increases with the thickness of material traversed, reaches a maximum, and then decreases again. A description is given of the reliable counters constructed, a high-voltage source working from the town supply, and a circuit selecting only the coincident discharges of the counter tubes. The thickness of copper under which a maximum of secondary rays occurs can be calculated by means of the theoretical formulæ of Bhabha and Heitler. The calculated and experimentally found thicknesses show good agreement. The absorption of the secondary rays from copper in lead shows the presence of two components of secondary rays having absorption coefficients 0·69 and 0·30 cm.$^{-1}$Pb respectively.

W. G. SHARPLES: A *coup de poing* factory site from the Nieuwveld. A site at Steenkamp's Poort in the Nieuwveld is surprisingly rich in *coups de poing*, in dolerite and lydianite. Associated with them are a number of flakes and points. Many of the *coups de poing* appear to be made from rough fragments of rock. Some are typically Stellenbosch and some typically Fauresmith in appearance. It is suggested that this is a factory site, and that it is an example of Stellenbosch developing into Fauresmith.

Moscow

Academy of Sciences (*C.R.*, **20**, Nos. 2–3, 1938).

G. J. KHAJALIA: The theory of conformic representation of doubly connected domains.

S. SOBOLEFF: The Cauchy problem for quasi-linear hyperbolic equations.

S. ROSSINSKI: (1) Permanent conjugated systems and permanent orthogonal systems of the surfaces of rectilinear congruences. (2) Permanent isoclinic systems of the surfaces of rectilinear congruences.

S. G. MICHLIN: Reduction of singular integral equations to the equivalent equations of Fredholm.

S. A. TCHOUNIKHIN: The Sylow subgroups of simple groups.

P. M. RIZ and N. V. ZVOLINSKY: Torsion of a prismatic bar simultaneously subjected to tension.

V. S. IGNATOVSKIJ: Contribution to the grid theory.

N. MALKIN: Propagation of heat in a medium of several layers.

A. I. ALIKHANOV and V. P. DŽELEPOV: (1) Positron spectrum of an active thorium deposit. (2) Positron spectrum emitted by lead on irradiation with thorium C″ γ-rays.

E. KONORSKY: Irreversible and reversible changes of magnetization in ferromagnetics under tension, and mode of increasing magnetic field.

V. I. LIKHOFF and V. I. PAVLOFF: Method for the augmentation of tension of continuous current with the aid of condensors.

M. MARKOV: Non-elastic dispersion of photons about nuclei with pair-production.

J. I. FRENKEL: Mechanism of muscular activity.

V. FEOFILAKTOV and A. ONIŠČENKO: Synthesis of oxyproline (γ-oxypyrolidine-α-carboxylic acid).

V. O. LUKASHEVITCH: Azoxy compounds. Mechanism of their formation during the reduction of nitro-compounds with sodium amalgam.

N. A. SCHLESINGER, I. B. FEIGELSON and A. I. SPIRIAGINA: Solubility of sodium borates in saturated solutions of sodium chloride in the presence of magnesium sulphate.

A. T. GLADYSHEV and J. K. SYRKIN: Equilibrium and kinetics of the formation of oxonium compounds.

D. M. MICHLIN: Hydroxylamine formed in plants in the course of nitrate and nitrite assimilation.

D. L. TALMUD: Structure of protein molecules and their catalytic properties.

S. M. MANSKAYA: Oxidation processes in wine.

P. P. AVDUSIN and M. A. ZVETKOVA: On the 'structure' of pore spaces of arenaceous oil collectors.

DONTCHO KOSTOFF: Abnormal meiotic processes induced by acenaphthene.

R. A. MASING: Increased variability of heterozygotes for a lethal in *Drosophila melanogaster*.

S. M. BUKASOV: *Solanum boergeri* Buk.—a new potato species from Uruguay.

J. V. RAKITIN and P. M. SHUMOVA: Degeneration of potato cultivated in the south.

A. A. YATSENKO-KHMELEVSKY: 'Physiological drying' of beech timber.

N. P. GLINYANY: Vernalization of grain at the time of the embryo formation.

A. N. KLECHETOV: Effect of tau-saghyz seed treatment with the preparation 'granosan'.

I. V. Kozhantchikov: Role of metamorphosis in the zonal distribution of insects.

B. A. Zenkovich: Milk of large cetaceans.

I. I. Morosow: Inhibition and recovery of the regenerative processes in the extremities of axolotl.

J. A. Vinnikov: Growth and transformation *in vitro* of the iridescent portion of the choroid coat (tapetum).

B. I. Balinsky: Determination of endodermal organs in Amphibia.

V. Fomitchev: *Rugosa* corals from the Middle and Upper Carboniferous deposits of the Donetz basin.

A. I. Argyropulo: Fauna of the Tertiary Cricetidae of the U.S.S.R.

I. A. Efremov: Discovery of a Triassic anomodont in the Orenburg province.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, November 28

University College, London, at 5.30.—Prof. Jacques Errera: "Intermolecular Forces and Infra-Red Spectroscopy".*

Royal Geographical Society, at 8.30.—Miss Freya Stark: "An Exploration in the Hadhramaut and Journey to the Coast".

Thursday, December 1

London School of Hygiene and Tropical Medicine, at 5.—Prof. F. W. Twort, F.R.S.: "The Position of Viruses in the Organic World" (Brown Institution Lectures. Succeeding lectures on December 2, 5, 8 and 9).*

Chemical Society, at 8.—Discussion on "Aggregation of Ions in Paraffin—Chain Salt Solutions", to be opened by Dr. G. S. Hartley.

Friday, December 2

Institution of Naval Architects (at the Institution of Mechanical Engineers), at 6.—S. S. Cook, F.R.S.: "Sir Charles Parsons and Marine Propulsion" (Parsons Memorial Lecture).

Geologists' Association (at University College, London), at 7.30.—Prof. W. W. Watts, F.R.S.: "The Work of Charles Lapworth".

Royal Institution, at 9.—Viscount Samuel: "The Scientist and the Philosopher".

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Head of the Engineering Department of Hendon Technical Institute—H. M. Walton (T.), Education Offices, 10 Great George Street, Westminster, S.W.1 (December 9).

Research Assistant in Biochemistry in the Imperial College of Science and Technology, Royal College of Science, South Kensington, London, S.W.7—The Secretary (December 10).

Senior Lecturer in Civil Engineering in the University of the Witwatersrand—The Secretary, High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2 (December 12).

Lecturer in Mathematical Physics in the University of South Africa—The Secretary.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Forest Products Research Records No. 26 (Seasoning Series No. 5): Kiln-Drying Schedules. By R. G. Bateson and R. E. Hodge. Pp. ii+21. (London: H.M. Stationery Office.) 6*d*. net. [411

University of London: University College. Calendar, Session 1938–1939. Pp. 12+lxxxi+612+13–22. (London: Taylor and Francis, Ltd.). [411

Machinery Design and the Control of Moth Pests in Factories. Pp. 32. 2*s*. net. Factory Fittings, Mountings, Appliances and Furnishings, with regard to the Control of Moth Pests. Pp. 40. 2*s*. 6*d*. net. (London: British Association of Research for the Cocoa, Chocolate, Sugar Confectionery and Jam Trades.) [711

Battersea Polytechnic. Report on the Work of the Session 1937–38 by the Principal, being the 45th Annual Report presented to the Governing Body. Pp. 36. (London: Battersea Polytechnic.) [811

The Journal of the Institute of Metals. Vol. 62. Edited by S. C. Guillan. Pp. 334+38 plates. (London: Institute of Metals.) 31*s*. 6*d*. [811

Metallurgical Abstracts (General and Non-Ferrous). Vol. 4 (New Series). Edited by G. Shaw Scott. Pp. vi+861. (London: Institute of Metals.) £4, including 2 vols. of the "Journal". [811

Other Countries

Reprint and Circular Series of the National Research Council. No. 108: Third Report of the Committee on Photochemistry. Pp. 156. (Washington, D.C.: National Research Council.) 1.50 dollars. [411

Bulletin of the American Museum of Natural History. Vol. 74, Art. 7: The Stingless Bees (Meliponidæ) of British Guiana and some Related Forms. By Herbert F. Schwarz. Pp. 437–508+plates 52–62. (New York: American Museum of Natural History.) [411

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 90. A Small Collection of Fresh-Water Fishes from Eastern Cuba. By Henry W. Fowler. Pp. 143–148. Description of a New Carangid Fish from New Jersey. By Henry W. Fowler. Pp. 149–152. (Philadelphia: Academy of Natural Sciences.) [411

New Zealand. Annual Report for the Year 1937–38 of the New Zealand Standards Institute. Pp. 16. (Wellington: Government Printer.) 9*d*. [411

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 120: Some Effects of Green Manuring on Citrus Trees and on the Soil. By E. S. West and A. Howard. Pp. 36+9 plates. Pamphlet No. 84: A Population Study of the Red-legged Earth Mite (*Halotydeus destructor*) in Western Australia; with Notes on Associated Mites and Collembola. By K. R. Norris. Pp. 23. (Melbourne: Government Printer.) [711

Imperial Council of Agricultural Research. Scientific Monograph No. 12: Fungi of India, Supplement 1. By B. B. Mundkur. Pp. iv+54. (Delhi: Manager of Publications.) 1.6 rupees; 2*s*. 6*d*. [711

Indian Forest Records (New Series.) Entomology, Vol. 3, No. 11: Entomological Investigations on the Spike Disease of Sandal (3) Heteroptera (Hemipt.). By N. C. Chatterjee. Pp. 213–226. 8 annas; 9*d*. Entomology, Vol. 3, No. 12: Immature Stages of Indian Coleoptera (24, Curculionidæ, cont.). By J. C. M. Gardner. Pp. 227–262+6 plates. 1.6 rupees; 2*s*. (Delhi: Manager of Publications.) [711

Southern Rhodesia. Geological Survey Bulletin No. 34: The Geology of the Lower Umfuli Gold Belt, Hartley and Lomagundi Districts. By A. E. Phaup and F. O. S. Dobell. Pp. v+150+12 plates. (Salisbury: Government Stationery Office.) 5*s*. [711

Smithsonian Miscellaneous Collections. Vol. 97, No. 7: The Direct-Historical Approach in Pawnee Archeology. By Waldo R. Wedel. (Publication 3484.) Pp. 21+6 plates. (Washington, D.C.: Smithsonian Institution.) [711

Indian Lac Research Institute. A Note on the Iodine Absorption by Lac and similar Natural Resins and a Rapid Method for its Estimation (Work under United Kingdom Scheme). By Dr. A. Karim and Dr. Dorothy E. Cook. Pp. 10. 2 annas. A Study of the Mechanical and Electrical Properties of some Commercial Standard Lacs (Work under United Kingdom Scheme). By Dr. A. Karim. Pp. 21. 2 annas. Annual Report for the Financial Year 1937–38. Pp. ii+43. Bulletin No. 28: Conservation of the Baisakhi Ber (Z. Jujuba) Brood of the Lac Insect, and Possibilities of Effecting Better Returns from Lac Cultivation on Ber. By P. S. Negi. Pp. 14+9 plates. 4 annas. Bulletin No. 29: Contribution to the Study of the Bleaching of Lac. Part 1: The Action of the Chlorine-Bleach on the Resin Constituents of Lac. By N. N. Murty. Pp. 17. 2 annas. Bulletin No. 30: Shellac Plastics. Part 1: Compositions containing Urea. By S. Ranganathan. Pp. 8. 2 annas. Bulletin No. 31: Fluorometric Determination of the Acid and Saponification Values of Lac. By N. N. Murty and H. K. Sen. Pp. 8. 2 annas. (Namkum: Indian Lac Research Institute.) [811

1587–1937, Hortus Academicus Lugduno Batavus, The Development of the Gardens of Leyden University. By H. Veendorp and L. G. M. Baas Becking. Pp. 218. (Hariemi: Ex Typographia Enschedaiana.) 8.60 florins. [811

Catalogues, etc.

Aeronautik und Meteorologie in Auswahl: Bücher, Zeitschriften, Abhandlungen. (Antiquariatskatalog Nr. 724.) Pp. 32. Reine und angewandte Chemie: Zeitschriften, Sammelwerke, Bücher und Abhandlungen. (Antiquariatskatalog Nr. 725.) Pp. 242. (Leipzig: Gustav Fock, G.m.b.H.)

Dent's Almanack. No. 1, 1938. Pp. 96+16 plates. (London: J. M. Dent and Sons, Ltd.).